VOLUME 28 / NUMBER 24
DECEMBER 23, 1990
ACC. NOS. N90-29299 TO N90-30170

STAR
AN ABSTRACT JOURNAL

Scientific and Technical Aerospace Reports

PRODUCED BY THE
SCIENTIFIC AND TECHNICAL
INFORMATION
DIVISION

NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WHAT YOU CAN DO FOR *STAR*

All users of this abstract service are urged to forward reports to be considered for announcement in *STAR*. This will aid NASA in its efforts to provide the fullest possible coverage of all scientific and technical publications that might support aeronautics and space research and development. If you have prepared relevant reports (other than those that you will transmit to NASA, DOD, or DOE through the usual contract- or grant-reporting channels), please send them for consideration to the NASA Scientific and Technical Information Facility, P.O. Box 8757, BWI Airport, MD 21240.

Reprints of journal articles, book chapters, and conference papers are also welcome. These will be considered for announcement in *STAR's* companion journal, *International Aerospace Abstracts*.

You may specify a particular source to be included in a report announcement if you wish; otherwise the report will be placed on public sale at the National Technical Information Service. Copyrighted publications will be announced but not distributed or sold.

PURCHASE OF *STAR*

The semimonthly issues are available to registered users on annual subscription from the NASA Scientific and Technical Information Facility, ATTN: Registration Services, P.O. Box 8757, BWI Airport, MD 21240. *STAR* is publicly available on annual subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

PUBLISHED BY:

UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION DIVISION
Scientific and Technical Aerospace Reports, Volume 28, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by RMS Associates.

The Administrator of the National Aeronautics and Space Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through March 22, 1991.

US ISSN 0036-8741

Scientific and Technical Aerospace Reports (STAR) is issued twice a month and contains abstracts and indexes of meeting papers, conference proceedings, and unlimited distribution reports that have been added to the NASA Scientific and Technical Information Database during the preceding period. These citations may also be accessed online via NASA/RECON or via AIAA's Aerospace Database (File 108) through Dialog Information Services, Inc.

STAR subject coverage includes all aerospace-related areas that will help NASA achieve its mission. Material is gathered from all over the world and includes significant input from many countries under exchange and access agreements.

Consult the indexes at the back of this volume to help zero in on what you are looking for. These include:

Subject Index
Personal Author Index
Corporate Source Index
Contract Number Index
Report/Accession Number Index

STAR's companion abstract journal *International Aerospace Abstracts* should be used if you are looking for references to periodicals, books, and published meeting papers or conference proceedings.

Questions and comments should be addressed to:

NASA Scientific and Technical Information Facility
User Services
P.O. Box 8757
BWI Airport, MD 21240
301-621-0150

VOLUME 28 NUMBER 24 / DECEMBER 23, 1990

TABLE OF CONTENTS

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

01 AERONAUTICS (GENERAL) 3417

02 AERODYNAMICS 3417

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

03 AIR TRANSPORTATION AND SAFETY 3422

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 3423

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 3431

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION 3433

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER 3433

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL 3435

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) 3435

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics.*

12 ASTRONAUTICS (GENERAL) 3437

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

13 ASTRODYNAMICS 3438

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 3438

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

15 LAUNCH VEHICLES AND SPACE VEHICLES N.A.

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

16 SPACE TRANSPORTATION N.A.

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING 3439

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 3439

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION 3441

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 3441

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) 3442

24 COMPOSITE MATERIALS 3442

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY 3445

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 3448

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 3453

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS 3457

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING N.A.

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 3458

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 3459

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING 3462

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER 3466

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY 3471

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS 3473

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING 3474

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 3477

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 3478

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) 3483

43 EARTH RESOURCES AND REMOTE SENSING 3483

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION 3484

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION 3486

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS 3488

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY 3493

Includes weather forecasting and modification.

48 OCEANOGRAPHY 3496

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) 3497

52 AEROSPACE MEDICINE 3497

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES 3498

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT 3500

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY N.A.

Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) N.A.

60 COMPUTER OPERATIONS AND HARDWARE 3523

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE 3523

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS 3532

Includes computer networks and special application computer systems.

63 CYBERNETICS 3534

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS 3536

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY 3539

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS N.A.

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS 3541

Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) 3541

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or soiar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 3542
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 3543
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 3544
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 3544
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 3547
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 3550
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 3555
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 3556
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 3556
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 3559
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 3559
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) 3560

89 ASTRONOMY 3560
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 3561
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 3563
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 3563
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 3564
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

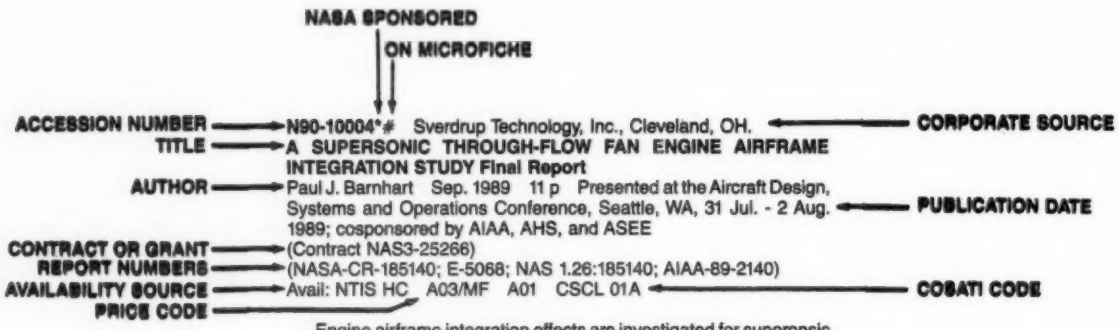
Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 3565

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-61
CORPORATE SOURCE INDEX I-69
CONTRACT NUMBER INDEX I-81
REPORT/ACCESSION NUMBER INDEX .. I-85
APPENDIX—ABOUT STAR A-1

TYPICAL CITATION AND ABSTRACT


NASA SPONSORED
ON MICROFICHE
ACCESSION NUMBER
N90-10004*# Sverdrup Technology, Inc., Cleveland, OH.
CORPORATE SOURCE
TITLE
A SUPERSONIC THROUGH-FLOW FAN ENGINE AIRFRAME INTEGRATION STUDY Final Report
AUTHOR
Paul J. Barnhart Sep. 1989 11 p Presented at the Aircraft Design, Systems and Operations Conference, Seattle, WA, 31 Jul. - 2 Aug. 1989; cosponsored by AIAA, AHS, and ASEE
PUBLICATION DATE
CONTRACT OR GRANT
(Contract NAS3-25266)
REPORT NUMBERS
(NASA-CR-185140; E-5068; NAS 1.26:185140; AIAA-89-2140)
AVAILABILITY SOURCE
Avail: NTIS HC A03/MF A01 CSCL 01A
COSATI CODE
PRICE CODE

Engine airframe integration effects are investigated for superonsic through-flow fan engines installed on a Mach 3.20 supersonic cruise vehicle. Six different supersonic through-flow fan engine installations covering the effects of engine size, nacelle contour, nacelle placement, and approximate bypass plume effects are presented. The different supersonic through-flow fan installations are compared with a conventional turbine bypass engine configuration on the same basic airframe. The supersonic through-flow fan engine integrations are shown to be comparable to the turbine bypass engine configuration on the basis of installed nacelle wave drag. The supersonic through-flow fan engine airframe integrated vehicles have superior aerodynamic performance on the basis of maximum lift-to-drag ratio than the turbine bypass engine installation over the entire operating Mach number range from 1.10 to 3.20. When approximate bypass plume modeling is included, the supersonic through-flow fan engine configuration shows even larger improvements over the turbine bypass engine configuration. Author

VOLUME 28 NUMBER 24 / DECEMBER 23, 1990

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N90-29299# Federal Aviation Administration, Washington, DC. Vertical Flight Program Office.
FAA ROTORCRAFT RESEARCH, ENGINEERING, AND DEVELOPMENT BIBLIOGRAPHY 1962-1989
Robert D. Smith May 1990 169 p
(AD-A224256; DOT/FAA/RD-90/1) Avail: NTIS HC A08/MF A01 CSCL 01/3

The FAA Helicopter/Heliport Research, Engineering, and Development - Bibliography, 1964 to 1986 and FAA Rotorcraft Research, Engineering, and Development Bibliography, 1962 to 1988, are both supplemented. Both bibliographies are limited to documents in which the research, engineering, and development elements of the FAA were involved as sponsors, participants, or authors. This bibliography contains the abstracts of 68 technical reports. The indexes address these 68 reports as well as the 53 reports in FAA/DS-98/03 and the 133 reports in FAA/PM-86/47. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N90-29300*# Eloret Corp., Palo Alto, CA.
THEORETICAL INVESTIGATION OF NON-EQUILIBRIUM CHEMISTRY AND OPTICAL RADIATION IN HYPERSONIC FLOW FIELDS Final Report
Ellis E. Whiting 15 Feb. 1990 7 p
(Contract NCC2-444)
(NASA-CR-186335; NAS 1.26:186335) Avail: NTIS HC A02/MF A01 CSCL 01A

Future space vehicles returning from distant missions or high earth orbits may enter the upper regions of the atmosphere and use aerodynamic drag to reduce their velocity before they skip out of the atmosphere and enter low earth orbit. The Aeroassist Flight Experiment (AFE) is designed to explore the special problems encountered in such entries. A computer code was developed to calculate the radiative transport along line-or-sight in the general 3-D flow field about an arbitrary entry vehicle, if the temperatures and species concentrations along the line-of-sight are known. The radiative heating calculation at the stagnation point of the AFE vehicle along the entry trajectory was performed, including a detailed line-by-line accounting of the radiative transport in the vacuum ultraviolet (below 200 nm) by the atomic N and O lines. A method was developed for making measurements of the haze particles in the Titan atmosphere above 200 km altitude. Several other tasks of a continuing nature, to improve the technical ability to calculate the nonequilibrium gas dynamic flow field and radiative heating of entry vehicles, were completed or advanced. B.G.

N90-29301 Boston Univ., MA.
A POTENTIAL-VORTICITY DECOMPOSITION FOR THE BOUNDARY INTEGRAL EQUATION ANALYSIS OF VISCOUS FLOWS Ph.D. Thesis
Philip Paul Beauchamp 1990 203 p
Avail: Univ. Microfilms Order No. DA9015957

A computational technique is developed based on an exact formulation of the viscous flow problem using a new potential-vorticity decomposition called the Poincare decomposition. In this decomposition the component of velocity due to the rotational portion of the flow is zero over the majority of the irrotational region. The time accurate solution of the incompressible, two-dimensional, viscous flow past a body in arbitrary motion is addressed. The technique developed employs the boundary integral equation method to determine the velocity distribution in the field about the body, while the evolution of the vorticity field in time is solved using a finite difference method. Also shown is the general solution of the Poincare decomposition for curvilinear coordinates. Three techniques are used in examining the generation of vorticity at the surface of the body by treating the continuous motion of the surface as the limit of a series of relaxation periods separated by discrete velocity impulses. The specification for boundary and initial conditions is addressed. The results demonstrate that the method can be used for the computation of two-dimensional, incompressible viscous flows and that continued development of the technique is warranted. Numerical results using the technique are presented for flows both with and without solid bodies in the field. The free field solutions examine the development of an initially Gaussian distribution of vorticity in the field. These results are compared to the exact solution for this problem and are used to validate the finite difference solvers for the vorticity evolution and to ascertain the impact of numerical precision on the solver. The motion of a body in the field is illustrated by the computation of the laminar flow past a flat plate at various conditions. Dissert. Abstr.

N90-29302# JAI Associates, Inc., Mountain View, CA.
NUMERICAL SIMULATIONS OF BLADE-VORTEX INTERACTIONS AND LIFTING HOVERING ROTOR FLOWS Final Technical Report, Feb. 1988 - Feb. 1990
Ganapathi R. Srinivasan Apr. 1990 68 p
(Contract DAAL03-88-C-0006)
(AD-A224238; JAIA-TR-90-1; ARO-25575.7-EG) Avail: NTIS HC A04/MF A01 CSCL 01/1

Viscous, 3-D numerical solutions of two related problems of a helicopter rotor are presented. An implicit, finite difference numerical procedure is used for the solution of the thin layer Navier-Stokes equations to simulate the flowfield solutions of helicopter rotor blade encountering a passing concentrated line vortex, and a lifting hovering rotor, at both sub- and super-critical flowfield conditions. For the first problem, the Euler equations were also solved independently to assess the importance of the viscous effects in the interacting flowfield. A prescribed vortex method is adopted to preserve the structure of the interacting vortex. Both parallel and oblique blade-vortex interactions were calculated. The second problem considered is that of calculating lifting hovering rotor flowfields without using any ad hoc wake models. The induced effects of the wake, including the interaction of tip vortices with successive blades, are captured as a part of the overall flowfield solution and hence no wake models are used. In order to preserve

the structure of the vortex wake, a completely upwind finite difference numerical procedure is used for this problem. Comparison of the numerical results show excellent agreement with the experimental data and with the previously published Navier-Stokes calculations that used a simple wake model. GRA

N90-29303# Ballistic Research Labs., Aberdeen Proving Ground, MD.
SUPERSONIC/HYPERSONIC AERODYNAMICS AND HEAT TRANSFER FOR PROJECTILE DESIGN USING VISCOUS-INVISCID INTERACTION Final Report, May 1989 - May 1990
Michael J. Nusca Jun. 1990 69 p
(AD-A224354; BRL-TR-3119) Avail: NTIS HC A04/MF A01 CSCL 16/2

An aerodynamic design code for axisymmetric projectiles has been developed using a viscous-inviscid interaction scheme. Separate solution procedures for inviscid (Euler) and viscous (boundary layer) flowfields are coupled by an iterative solution procedure. This code yields body surface flow profiles in less than one minute of run time on minicomputers. These surface profiles represent converged solutions to both the inviscid and viscous equations. the capability of computing local reverse flow regions is included. The procedure is formulated for supersonic and hypersonic Mach numbers including both laminar and turbulent flow. In addition, aerodynamic heating equations are used to compute heat transfer coefficient and local Stanton number from flow profiles. Computed surface pressure profiles for Mach numbers 2 thru 6 are compared to wind tunnel measurements on cone-cylinder-flare projectiles. Computed surface heat transfer coefficients are compared to results obtained from wind tunnel measurements on cone-cylinder-flare, flat plate, and blunt-cone models at Mach numbers 5 and 10. GRA

N90-29304# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
THE SECOND ARO WORKSHOP ON ROTORCRAFT INTERACTIONAL AERODYNAMICS Final Report
N. M. Komerath Apr. 1990 57 p Workshop held in Atlanta, GA, 26-27 Mar. 1990
(Contract DAAL03-90-G-0037)
(AD-A223310; GIT/AER-90-1; ARO-27619.1-EG-CF) Avail: NTIS HC A04/MF A01 CSCL 01/1

The proceedings of the workshop are presented. Some areas of research were as follows: Full scale investigation of rotor/fuselage interaction; Experimental rotorcraft flowfield research at LARC/ASTD; Computational rotorcraft research at LARC/ASTD; The efficient calculation of rotor flows including blade vortex interactions using vortex embedding; Studies of rotor-body interactions in forward flight; New vortex/surface interaction methods for the prediction of wake induced airframe loads; The interaction of a rotor wake and an airframe with and without flow separation; Interaction of discrete vortices in shear flows using high order computational schemes; The unsteady interaction of a 3-D vortex filament with a cylinder. GRA

N90-29305# Colorado Univ., Boulder.
DYNAMIC SEPARATION: SEARCH FOR THE CAUSE OF DYNAMIC STALL AND SEARCH FOR ITS CONTROL Final Report, 1 Feb. 1989 - 31 Aug. 1990
Peter Freymuth May 1990 4 p
(Grant AF-AFOSR-0241-88)
(AD-A223412; AFOSR-90-0687TR) Avail: NTIS HC A01/MF A01 CSCL 01/1

Dynamic separation was investigated for various configurations and forcing dynamics. The details which differentiate 2-D vortex dynamics from those involving 3-D aspects were investigated. In addition, different dynamic stall control strategies were tested. GRA

N90-29306# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
NUMERICAL SIMULATION SUPERSONIC FREE SHEAR LAYERS Semiannual Progress Report, 1 Dec. 1989 - 31 May 1990
L. J. Sankar and I. Tuncer Jun. 1990 15 p
(Contract N00014-89-J-1319)
(AD-A223771) Avail: NTIS HC A03/MF A01 CSCL 20/4

The objective of the current research is to study the mixing and stability characteristics of three dimensional supersonic free shear flows through a direct numerical solution of 3-D compressible flow equations. Supersonic shear flows are of interest to SCRAMJET engine designers. The successful operation of these engines requires rapid and efficient (i.e., minimum total pressure loss) mixing of supersonic airstreams and subsonic/sonic fuel streams. GRA

N90-29307# Calspan Corp., Arnold AFS, TN.
CAVITY AEROACOUSTICS Technical Paper, Oct. 1985 - Apr. 1990
Richard E. Dix and Carroll Butler (Air Force Armament Lab., Eglin AFB, FL.) Jun. 1990 36 p Presented at the Store Carriage, Interaction, and Release Conference, Bath, England
(AF Proj. 2567)
(AD-A223853; AFATL-TP-90-08) Avail: NTIS HC A03/MF A01 CSCL 01/1

Consider the retraction or hiding of items in a cavity that is closed and smooth to the flow over the body. At an appropriate time, doors or panels open as part of a desired operational sequence, and the storage volume, or cavity, together with the contents, are exposed to the external flow. Two important flow phenomena occur with exposure of a cavity in high speed aircraft: (1) development of a shear layer within which transition from the stagnant cavity environment to the active external flow occurs, and (2) the creation of a concomitant fluctuating pressure environment. A program of experiments has been undertaken since 1985 to investigate these phenomena which have resulted in a rather large data base describing the aeroacoustic environment associated with cavities of three different length-to-height ratios, equipped with a variety of acoustic suppression devices and doors, and exposed to external flows of subsonic and supersonic speeds. A series of experiments and the results are presented. GRA

N90-29308# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
COMPARISON OF WIND TUNNEL AIRFOIL PERFORMANCE DATA WITH WIND TURBINE BLADE DATA
C. P. Butterfield, George N. Scott, and Walt Musial Jul. 1990 8 p Presented at the 25th Intersociety Energy Conversion Engineering Conference, Reno, NV, 12-17 Aug. 1990
(Contract DE-AC02-83CH-10093)
(DE90-000343; SERI/TP-254-3799; CONF-900801-24) Avail: NTIS HC A02/MF A01

Horizontal-axis wind turbine (HAWT) performance is usually predicted by using wind tunnel airfoil performance data in a blade element momentum theory analysis. This analysis assumes that the rotating blade airfoils will perform as they do in the wind tunnel. However, when HAWT performance is measured in full-scale operation, it is common to find that peak power levels are significantly greater than those predicted. This has led to empirical corrections to the predictions. Viterna and Corrigan proposed the most popular version of this correction. But very little insight has been gained into the basic cause of this discrepancy. The Solar Energy Research Institute (SERI), funded by the U.S. Department of Energy (DOE), has conducted the first phase of an experiment focused on understanding the basic fluid mechanics of HWAT aerodynamics. Results to date have shown that unsteady aerodynamics exist during all operating conditions and dynamic stall can exist for high yaw angle operation. Stall hysteresis occurs even for small yaw angles, and delayed stall is a very persistent reality in all operating conditions. Delayed stall is the result of a leading-edge suction peak remaining attached through angles of attack (AOAs) up to 30 degrees. Wind tunnel results show this

peak separating from the leading edge at 18 degrees AOA. The effect of this anomaly is to raise normal force coefficients and tangent force coefficients for high AOA. Increased tangent forces will directly affect HAWT performance in high wind speed operation. This report describes pressure distribution data resulting from both wind tunnel and HAWT tests. A method of bins is used to average the HAWT data, which are compared to the wind tunnel data. The analysis technique and the test setup for each test are described. DOE

N90-29309*# Vigyan Research Associates, Inc., Hampton, VA.
A PACKAGE FOR 3-D UNSTRUCTURED GRID GENERATION, FINITE-ELEMENT FLOW SOLUTION AND FLOW FIELD VISUALIZATION Final Report
Paresh Parikh, Shahyar Pirzadeh, and Rainald Loehner Sep. 1990 104 p
(Contract NAS1-18670)
(NASA-CR-182090; NAS 1.26:182090) Avail: NTIS HC A06/MF A01 CSCL 01A

A set of computer programs for 3-D unstructured grid generation, fluid flow calculations, and flow field visualization was developed. The grid generation program, called VGRID3D, generates grids over complex configurations using the advancing front method. In this method, the point and element generation is accomplished simultaneously, VPLOT3D is an interactive, menudriven pre- and post-processor graphics program for interpolation and display of unstructured grid data. The flow solver, VFLOW3D, is an Euler equation solver based on an explicit, two-step, Taylor-Galerkin algorithm which uses the Flux Corrected Transport (FCT) concept for a wriggle-free solution. Using these programs, increasingly complex 3-D configurations of interest to aerospace community were gridded including a complete Space Transportation System comprised of the space-shuttle orbitor, the solid-rocket boosters, and the external tank. Flow solutions were obtained on various configurations in subsonic, transonic, and supersonic flow regimes. Author

N90-29310# Gesamthochschule, Essen (Germany, F.R.). Fachbereich Energie-, Verfahrens- und Elektrotechnik.
CALCULATION OF TURBULENT AIR STREAMS IN DRIVER CABS Ph.D. Thesis [BERECHNUNG TURBULENTER LUFTSTROEMUNGEN IN FAHRERKABINEN]
Jan Ernst Janssen 1989 94 p In GERMAN Sponsored by Bundesforschungsanstalt fuer Landwirtschaft
(ETN-90-97320) Avail: NTIS HC A05/MF A01

The aim is to prove that the numerical calculation of air staeams is an alternative to costly and long model tests for obtaining the velocity and temperature fields in unlimited and limited space. The method is based on a direct computation of the velocity components. In the algorithm, turbulence terms are integrated, based on the eddy viscosity principle for the simulation of the turbulent flow. It was shown that the flow field does not vary opposite isothermal walls and the temperature distribution depends on the turbulent Prandtl number. ESA

N90-29311# Ecole Nationale d'Ingenieurs de Constructions Aeronautiques, Toulouse (France). Lab. d'Aerodynamique et de Propulsion.
THERMAL TRANSFERS IN UNSTEADY COMPRESSIBLE INVISCID FLOW Final Report [TRANSFERTS THERMIQUES EN ECOULEMENT DECOLLE COMPRESSIBLE INSTATIONNAIRE, RAPPORT FINAL]
Florence Pavie 1990 102 p In FRENCH
(Contract DRET-88-1501)
(ETN-90-97557) Avail: NTIS HC A06/MF A01

A method for calculating supersonic flow around a two dimensional or asymmetric compression slope is developed. Only the steady solution obtained as asymptotic limit is considered. A numerical solution for the compressible unsteady Navier-Stokes equations is obtained. Two methods are applied for solving the laminar flow equations and the results are compared. The Baldwin-Lomax and Jones-Launder turbulence models are applied in the MacCormack scheme. ESA

N90-29312# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de la Physique Generale.
FEASIBILITY OF THE TEMPERATURE MEASUREMENTS IN HYPERSONIC FLOW BY MULTIBEAM COHERENT RAMAN ANTI-STOKES SCATTERING Final Report [FAISABILITE DE MESURES DE TEMPERATURES PAR DRASC MULTIRAIE EN ECOULEMENT HYPERSONIQUE, RAPPORT FINAL]
M. Lefebvre and M. Pealat Jan. 1990 28 p In FRENCH
(Contract DRET-89-001-23)
(ONERA-RF-56/7131-PY; ETN-90-97562) Avail: NTIS HC A03/MF A01

The feasibility of temperature measurements by multibeam coherent Raman anti-Stokes scattering is demonstrated. Tests are performed in a cell containing about 10 mb of heated nitrogen. Between 300 and 700 K, the temperature standard deviation is inferior to 5 percent. This technique can be applied to sounding media with pressure under 1 mb. Experiments under continuous discharges and under nitrogen microwave discharge are carried out. The instantaneous measurement of the temperature of vibration is also discussed. ESA

N90-29313# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
THEORETICAL STUDY OF THE INTERACTION BETWEEN AN OBLIQUE SHOCK WAVE AND A TURBULENT BOUNDARY LAYER FROM A HEATED WALL Final Report [ETUDE THEORIQUE DE L'INTERACTION ENTRE UNE ONDE DE CHOC OBLIQUE ET UNE COUCHE LIMITE TURBULENTE SE DEVELOPPANT SUR UNE PAROI CHAUFFEE: RAPPORT DE SYNTHESE FINAL]
R. Benay Dec. 1989 120 p In FRENCH
(Contract DRET-87-34-001)
(ONERA-RSF-87/7078/AY-100-A; ETN-90-97566) Avail: NTIS HC A06/MF A01

The theoretical analysis of the interaction resulting from the reflection of an oblique shock wave on a turbulent boundary layer is presented. The turbulent boundary layer is developed on a heated wall. The results given by three theoretical models concerning the prediction of average parameters and flow turbulence are discussed. The models considered are the Baldwin-Lomax algebraic model, the transport equations model and the algebraic stress model. ESA

N90-29314# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
MEASUREMENT TECHNIQUES FOR HYPERSONIC FLOWS
1990 390 p Lecture series held in Rhode-Saint-Genese, Belgium, 28 May - 1 Jun. 1990
(VKI-LS-1990-05; ISSN-0377-8312; ETN-90-97623) Avail: NTIS HC A17/MF A03

The objective was to present the state of the art in the following non-intrusive methods which are currently employed or under development for application to hypersonic flows: interferometry, laser Doppler velocity, velocity interferometry, electron beam methods, coherent anti-Stokes Raman scattering spectroscopy, laser induced fluorescence, thermographic phosphors, and infrared thermography. In each case, the underlying theory, application methods, and limitations are stressed. Since flight testing is an important component in the design of hypersonic vehicles, the instrumentation requirements for such applications was discussed. For individual titles, see N90-29315 through N90-29325.

N90-29315# Institut Franco-Allemand de Recherches, Saint-Louis (France).
INTERFEROMETRY
G. Smeets *In* VKI, Measurement Techniques for Hypersonic Flows 1990 40 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

A survey on optical interferometry with main emphasis on the application it has found in the aerodynamic and gas dynamic research is given. With a great number of selected examples, its potential, especially in the field of high speed flow diagnostics, is

demonstrated. Classical reference beam interferometry based on Mach-Zehnder interferometers in combination with spark light sources are addressed. Differential interferometers are discussed and shown to be a cheap and very effective alternative. The great number of new techniques originating from a combination of the different interferometers with light beams from a continuous wave laser are described. ESA

N90-29316# Institut Franco-Allemand de Recherches, Saint-Louis (France).
VELOCITY INTERFEROMETRY
G. Smeets *In* VKI, Measurement Techniques for Hypersonic Flows 1990 28 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

A survey on velocity measurements by direct Doppler techniques based on spectrometric analysis of the Doppler shift is given. A new system using an autostabilized Michelson spectrometer is described which was developed for recordings in gas flows or two-phase flows. By a great number of applications, its potentials, especially in the field of high speed gas flows, are demonstrated. The expected future possibilities for Doppler velocity measurements in hypersonic research are discussed. ESA

N90-29317# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LASER VELOCIMETRY
A. Boutier *In* VKI, Measurement Techniques for Hypersonic Flows 1990 70 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

The basic principles of laser velocimetry based on the Doppler effect are reviewed. The four optical setups are discussed and emphasis is given concerning the fringe configuration. The Michelson spectrometer velocimeter is mentioned. The different ways to measure three components simultaneously are described, as well as the various means to process electronically (or optically) the signals (including the new developments). Measurement accuracy, geometry of the setup, calibration, statistics, are discussed. A signal to noise ratio study points out the advantages of optical barrier setups (two spots or dashes velocimeters) in high velocity flows. The specific problems linked to the study of hypersonic flows are listed, requiring especially detailed investigations about the flow seeding, as well as improved processors. ESA

N90-29318# Sandia National Labs., Livermore, CA. Combustion Research Facility.
ELECTRON-BEAM FLUORESCENCE MEASUREMENTS IN HYPERSONIC FLOWS
Robert J. Cattolica *In* VKI, Measurement Techniques for Hypersonic Flows 1990 32 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

The Electron-Beam Fluorescence EBF technique applied to the measurement of flow properties of nitrogen is reviewed. A discussion of the suitability of performing EBF measurements in flight research applications is given. Considerations in designing an imaging spectrograph to be used to make spatially resolved density, rotational temperature, and vibrational temperature measurements using EBF in a hypersonic boundary layer are outlined. ESA

N90-29319# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
ELECTRON BEAM FOR VELOCITY DETERMINATION
K.-A. Buetefisch and C. Dankert *In* VKI, Measurement Techniques for Hypersonic Flows 1990 31 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

A new method to measure the flow velocity in a rarefied steady gas flow is described. In this method, the velocity is substantially derived from a time of flight measurement of ions, produced by a short pulsed high energy electron beam. Results for the application of the technique to measure the flow velocity in a steady rarefied flow and for the velocity determination of the expansion flow of a free jet are detailed. ESA

N90-29320# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).
APPLICATIONS OF LIF TO HIGH SPEED FLOWS
K.-A. Buetefisch, P. Krogmann, H. Voges, G. Meijer, A. Koch, and H. Wolfrum (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, Germany, F.R.) *In* VKI, Measurement Techniques for Hypersonic Flows 1990 21 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

The application of LIF (Laser Induced Fluorescence) to a jet flow, as well as to a hypersonic wind tunnel flow, discussed using NO in a concentration of less than 0.2 percent in a pure nitrogen at a density equivalent to a pressure of up to about 1 atmosphere at room temperature. So far, quenching has to be taken into account. The aim is to discuss the main steps which have to be performed if the LIF method is applied to a flow problem and quantitative results are expected. ESA

N90-29321# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CARS SPECTROSCOPY AND APPLICATIONS
Jean-Pierre Taran *In* VKI, Measurement Techniques for Hypersonic Flows 1990 30 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

The theory of CARS (Coherent Anti-Stokes Raman Scattering) is outlined. The implementation of the method, the instrumentation details and resonance enhancement are treated. Applications to combustion and to plasma physics are shown. Conclusions are detailed. CARS is noted as having become an essential diagnostics tool for combustion chemists and engineers, and has also allowed significant breakthroughs to be made in the Raman spectroscopy of gases. ESA

N90-29322# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany, F.R.).
LASER INDUCED FLUORESCENCE IMAGING APPLICATIONS
Peter Andresen *In* VKI, Measurement Techniques for Hypersonic Flows 1990 30 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

The elementary principles of Laser Induced Fluorescence (LIF), like emission and absorption of light, probabilities and rates for pulsed laser excitations as well as some basic spectroscopy, are discussed in considerable detail for the low density limit. Subsequently the problems arising in the application of LIF at higher densities by collisions (quenching) are described and the interpretation of the measurements is classified according to the type of problem (e.g., minority or majority species, quenching limit). Several methods to overcome the quenching problem, like saturated LIF, LIPF (Laser Induced Predissociation Fluorescence) and photoionization are suggested. Particular emphasis is given to two dimensional applications of LIF, where the laser is formed to a light sheet and cameras are used to take instantaneous pictures of species distributions in turbulent and non turbulent environments. The corresponding modern equipment, e.g., cameras, lasers, calibration procedures or combinations of cameras with spectrometers for fast spectroscopy analysis are described. For practical applications the detection limits are discussed for different species in two dimensional applications. Some typical results of two dimensional LIF with tunable excimer lasers at higher densities, as in flames of motors are used as examples to demonstrate todays power of two dimensional laser diagnostic methods. Some new results on the simultaneous use of Rayleigh scattering to determine total number densities are given. ESA

N90-29323# Physical Sciences, Inc., Andover, MA.
LASER INDUCED FLUORESCENCE: PRACTICAL APPLICATIONS
S. J. Davis and M. G. Allen *In* VKI, Measurement Techniques for Hypersonic Flows 1990 21 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

Diagnostic instrumentation for large scale, supersonic test facilities based upon a method known as Planar Laser Induced Fluorescence (PLIF) is addressed. Using this approach it is possible to obtain simultaneous, two dimensional distributions of species concentration and temperature. The PLIF technique and the instrumentation that is being developed based upon this method are described. Particular attention is given to some of the more practical aspects of the incorporation of these advanced diagnostics into large scale test stands. Recent laboratory results of velocity measurements using laser induced fluorescence are presented. ESA

N90-29324# Calspan Corp., Buffalo, NY.
THERMOGRAPHIC PHOSPHOR TECHNIQUE
K. W. Nutt *In* VKI, Measurement Techniques for Hypersonic Flows 1990 44 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

The use of the thermographic phosphor technique for measurement of convective heating on wind tunnel models in continuous flow facilities is described. The thermographic phosphor technique is a method of measuring the surface temperature of a model by measuring the temperature dependent emission of light that results when phosphor particles are activated by ultraviolet light. A special feature of this technique is that the thermographic phosphors are reversible and can be recycled without recoating the model surface. Basic system components, applications, data reduction approach, estimated data precision, advantages, and limitations of the technique are presented. An automated data acquisition approach that significantly reduces both the effort and time required to obtain final data is shown. The technique can provide plots of model surface temperatures and reduced data in heat transfer coefficient form. ESA

N90-29325# Naples Univ. (Italy). Faculty of Engineering.
INFRARED THERMOGRAPHY
G. M. Carlomagno *In* VKI, Measurement Techniques for Hypersonic Flows 1990 28 p (For primary document see N90-29314 24-02)
Avail: NTIS HC A17/MF A03

A review of current IR technology is addressed together with a critical analysis of the main parameters characterizing the performance of an IRSR (Infrared Scanning Radiometer). In particular, the formulation of a cascade model for the evaluation of the actual Modulation Transfer Function (MTF) of a sampled IR imaging system is discussed. Significant results referring to flow visualizations and heat transfer measurements performed with an IRSR in a blowdown hypersonic wind tunnel on a delta wing/ramp configuration and simple and double ellipsoidal models are discussed. Experimental tests within the European space program Hermes to develop the first European Space Shuttle are carried out. ESA

N90-29326# National Aerospace Lab., Tokyo (Japan).
INVESTIGATION OF ATP BLADES, PART 2. VALIDATION OF TWO-DIMENSIONAL VISCOUS FLOW SIMULATION CODES AROUND THIN AIRFOILS
Masahiro Fukuda, Naoki Hirose, Nobuhiro Kawai, Kazuhiro Nakahashi, and Eiji Kikuno Dec. 1989 63 p In JAPANESE; ENGLISH summary
(NAL-TR-1046; ISSN-0389-4010) Avail: NTIS HC A04/MF A01

The two-dimensional Navier-Stokes codes, NSFOIL and NS2D, are validated in terms practical thin-airfoils analysis for conventional propeller systems and compared with data obtained from wind-tunnel tests. This research was done as part of an aerodynamic research project on propeller blades for advanced turboprop (ATP) engines. The comparison was made at a Reynolds number of 8 million which was equivalent to the actual flight condition of ATP, and it was shown that these codes provide very effective tools for predicting nonlinear characteristics of thin-airfoils. In the course of careful comparison, some improvements on these codes were clarified. Author

N90-29327# National Aerospace Lab., Tokyo (Japan).
TRANSONIC 3-D EULER ANALYSIS OF FLOWS AROUND FANJET ENGINE AND TPS (TURBINE POWERED SIMULATOR). COMPARISON WITH WIND TUNNEL EXPERIMENT, EVALUATION OF TPS TESTING METHOD AND 3-D FLOW
Naoki Hirose, Keisuke Asai, and Katsuya Ikawa Nov. 1989 163 p In JAPANESE; ENGLISH summary
(NAL-TR-1045; ISSN-0389-4010) Avail: NTIS HC A08/MF A01

A three-dimensional Euler flow analysis code for Fan-Jet Engine and Turbine Powered Simulator (TPS) wind tunnel testing was developed utilizing MacCormack's scheme in the finite volume form for the purpose of confirming the validity of the TPS testing method in the NAL 2 x 2 m Transonic Wind Tunnel. The present analysis is made for the preliminary single axisymmetric TPS configuration. The wind tunnel experimental data for this model was available. The result of the numerical computation was compared with this data. The pressure distributions on the inlet cowl surface and core-jet cowl surface showed excellent agreement between the experiment and the computation. Different engine conditions between the real fan-jet engine and TPS simulation, i.e., difference of core-jet exhaust temperature and difference of mass flux relations, were analyzed, simulating respective engine conditions. The result shows that the two flows do not differ much qualitatively in the external flow field surrounding the exhaust jet plume. This comes from the fact that the use of the Euler code and the coarse mesh precluded obtaining a result amenable to quantitative discussion including the effects of viscosity and the turbulence/shock wave interactions in the plume field. Nevertheless the present result shows that the TPS testing method is a good full-configuration aerodynamic testing method for fan-jet engines. To extend the method, three-dimensional flow analysis was made and it revealed the angle of attack effects in the inlet flow field, such as the flow uniformity at the fan face and in the jet exhaust plume including the formation of a pair of longitudinal vortices in the shear layer between the jet plume and the external flow. Author

N90-29328# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.
A BOUNDARY-LAYER TRANSITION MODEL FOR THE NAVIER-STOKES COMPUTATION FOR A NATURAL-LAMINAR-FLOW AIRFOIL
Nobuhiro Kawai Nov. 1989 22 p
(NAL-TR-1038T; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Boundary-layer transition modeling is one of the most important deciding factors for the computation of natural laminar flow. So, a transition model for solving the two-dimensional Navier-Stokes equations with an algebraic turbulence model is presented. Michel's transition criterion is employed as the transition model and is compared with the conventional Baldwin-Lomax's transition criterion. Computation was made for the low-speed flow around a natural-laminar-flow airfoil and for the transonic flow around a supercritical natural-laminar-flow airfoil. The results computed by using the Michel's criterion agree well with the experimental results for low-speed flow and exhibit the bucket of the drag polar curve which is typical of a natural-laminar-flow airfoil. Author

N90-29329# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC FORCES ACTING ON A FINITE RECTANGULAR SLENDER BODY
Atsushi Tate and Takashi Yoshinaga Sep. 1989 49 p In JAPANESE; ENGLISH summary
(NAL-TR-1035; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

To estimate the nonlinear transient moment acting on spinning

square cylinders in a plane normal to the flow direction, the force and moment coefficients were measured for a semi-finite square cylinder (fineness ratio 5) settled in a wind tunnel. Yaw angle beta of the model was changed through a range of -45 to 45 deg and the Reynolds number was varied from 0.7 x 10(exp 5) to 5.7 x 10(exp 5). The results show: (1) Up to Beta is nearly equal to 10 deg the yawing moment coefficient C(sub n) increases gradually and the magnitude is less than 1/3 of the two-dimensional square cylinders. The C(sub n) begins to increase rapidly from Beta is nearly equal to 10 deg showing the maximum value at Beta = 16 deg. (2) The effect of the Reynolds number on the forces and the moments is small compared to that for a circular cylinder. (3) The velocity component directing to the finite end of the semi-finite square cylinder is great in the separated region around the cylinder. Author

N90-29330# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF HYPERSONIC VISCOUS FLOW FOR THE DESIGN OF H-2 ORBITING PLANE (HOPE)
Yukimitsu Yamamoto and Toshio Akimoto Aug. 1989 100 p In JAPANESE; ENGLISH summary
(NAL-TR-1028; ISSN-0389-4010) Avail: NTIS HC A05/MF A01

An unmanned winged vehicle for space transportation called H-2 Orbiting Plane (HOPE) is being studied by the National Space Development Agency of JAPAN (NASDA). Hypersonic computational fluid dynamics (CFD) analyses were performed for the 62A, 62B, and 62C HOPE configurations in order to investigate aerodynamic and aerothermodynamic characteristics. This research was performed jointly by the National Aerospace Laboratory (NAL) and NASDA. Numerical computations were carried out at M(sub infinity) = 7.0 and Reynolds number of 2.5 x 10(exp 6) at angles of attack from 0 to 40 degrees with and without yaw angles. Numerical results were compared with experimental data obtained from the hypersonic wind tunnel (HWT) at NAL. Author

N90-29331# National Aerospace Lab., Tokyo (Japan).
A NUMERICAL CALCULATION OF HYPERSONIC FLOW AROUND BLUNT BODIES USING UPWIND DIFFERENCE SCHEME
Yasuhiro Wada, Satoru Ogawa, and Norio Arai Jul. 1989 14 p In JAPANESE; ENGLISH summary
(NAL-TR-1025; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A numerical calculation of hypersonic flow around two-dimensional blunt bodies is presented. The Euler equations in conservation form are calculated by the first order accurate Osher upwind scheme. In this calculation, two types of boundary conditions on the body surface are tested. One is the conventional condition for Euler equations, and the other is a new form in which flux is conserved throughout the while flow field. Results show that the conventional boundary conditions do not provide reasonable solutions at high Mach numbers (M greater than 2.5), while the new boundary conditions do. The calculation is stably executed, and the shock is clearly captured from low to high Mach numbers. Author

N90-29332# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.
SOME TOPICS IN COMPUTATIONAL TRANSONIC AERODYNAMICS: REVISION
Naoki Hirose and Susumu Takanashi Apr. 1989 21 p Presented at the IUTAM Symposium Transsocicum 3, Geottingen, Federal Rep. of Germany, 24-27 May 1988
(NAL-TR-1018T; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Transonic aerodynamics research has been extensively conducted at NAL, Japan. Progress in CFD application is remarkable. N-S codes for airfoil, wing and full-configuration were developed. The codes revealed various viscous effects which otherwise were not predicted by past inviscid codes and were validated with wind tunnel test results. These N-S codes proved to be excellent as practical design tools for designing such aircraft as the Boeing-Japan 7J7. A versatile wing design code was combined with various flow solvers and used for practical purpose. Some topics of recent computational aerodynamics in transonic research are covered. Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N90-29333# National Aerospace Lab., Tokyo (Japan). Thermofluid Dynamics Div.
AIRLINE PRODUCTIVITY RELATING ON THE FUEL COST. (2): FUEL CONSUMPTION VALUES AND FUEL EFFICIENCY [SAIKIN NO EA-RAIN NO NENYUHI NIKANSURUICHIKOUSATSU. (2): NENRYO SHOUHI TO HIYOU TAI KOUKA]
Giichi Tanabe Mar. 1989 29 p In JAPANESE
(NAL-TM-604-2; ISSN-0452-2982; JTN-90-80191) Avail: NTIS HC A03/MF A01

Steady progress is being made toward newer aircraft designs which consume much less fuel. Actual data of fuel consumption of presently operating aircraft have been recorded. The data was arranged with emphasis on operating costs vs. transported freight, historical flight range rate change, transported freight, transportation efficiency, and fuel consumption. At U.S. airlines, in operations from 1985 to 1987 transportation efficiency is below 5000 kg km/kg and total cost per km ranged from $0.09 to $0.87. Therefore, because total costs are not reduced, even if transportation freight are reduced, it is very important to keep track of freight amounts as a management tool. Other problems in air transportation are alternative fuels and environmental pollution. In the 21st Century, liquefied hydrogen may be used as an alternative to fossil fuel. The reduction of environmental pollution must be considered. reducing pollution are required. NASDA

N90-29334# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
THE COST OF AIR SERVICE FRAGMENTATION
S. Tolofari, N. J. Ashford, and R. E. Caves Jul. 1990 97 p Sponsored by Science Research Council
(TT-9010; ISBN-0-904947-25-4) Avail: NTIS HC A05/MF A01

Examination of short-run economies of density for the seven British Airport Authority airports of the sample showed that the 'average' airport enjoys economies of density (i.e. economies of capacity utilization). An examination of these economies for the individual airports of the sample revealed generally the same trend for all the airports with the exception of London-Heathrow which was found to be experiencing diminishing returns to density. Analyses of short-run average and marginal costs showed that in 1986 and 1987, London-Gatwick had the lowest average variable and marginal costs followed by Heathrow; with both Stansted and Prestwick showing the highest costs. Savings in operating costs were found for different combinations of airport operating/service characteristics. High levels of passengers per air transport movement (i.e. average aircraft load) combined with high levels of terminal capacity utilization were found to result in reductions in operating costs. It is concluded as a result of the economies found with respect to passenger average loads, both in terms of cost savings and in terms of their contribution to output levels, that it is plausible to expect that even after an airport's capacity has reached its optimal utilization level, higher average loads can still be used as an operating strategy to achieve cost economies without further capacity expansions. Author

N90-29335 Civil Aviation Authority, London (England).
UK AIRMISSES INVOLVING COMMERCIAL AIR TRANSPORT: MAY - AUGUST 1989
Apr. 1990 88 p

(ISSN-0951-6301; ETN-90-97613) Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, England

Airmisses in the United Kingdom involving commercial air transport are addressed. Their origins, filed only by the pilots concerned, are discussed. The purpose of the reports, investigation and categorization are reported. The relating involvement of commercial air transport aircraft is discussed. Airmisses related to flying hours are discussed. Airmiss reports from May to August 1989 are given. Statistical tables of the number of incidents, the number of aircraft involved and airmisses related to flying hours are presented. ESA

N90-29336 Civil Aviation Authority, London (England).
AIRCRAFT EVACUATIONS: THE EFFECT OF PASSENGER MOTIVATION AND CABIN CONFIGURATION ADJACENT TO THE EXIT
Helen Muir, Claire Marrison, and Alyson Evans Nov. 1989 47 p Prepared in cooperation with Cranfield Inst. of Tech., England
(CAA-Paper-89019; ISBN-0-86039-406-9; ETN-90-97614)
Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, England

An experimental program of research into passenger behavior in aircraft emergencies is reported. The main objective was to investigate the influence of changes to the cabin configuration involving access to the emergency exits, on the rate at which passengers could evacuate an aircraft. The configurations evaluated involved a range of widths for the passageway through a bulkhead leading to floor level exits, and a range of seating configurations adjacent to a type 3 overwing exit. The configurations were evaluated when passengers were competing to evacuate the aircraft, as can happen in an accident when the conditions in the cabin become life threatening, and when passengers were evacuating in an orderly manner as occurs in aircraft certification evacuations and in some accidents. Detailed results are given. The results suggested that the optimum distance between the seat rows either side of the exit would involve a vertical seat projection of between 13 and 25 inches. ESA

N90-29337# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
TESTS FOR AIRCRAFT INTERIOR MATERIALS IN FIRE ACCIDENT
M. A. D. vanderHeijde May 1989 89 p
(LR-622; ETN-90-97635) Avail: NTIS HC A05/MF A01

A survey of terms often used in connection with aircraft interior materials flammability tests is given. A description of a lot of often referred to small scale test methods and of some full scale test methods is given. The effects of inhalation of toxic gases and exposure to radiant heat on human beings are described. A full description of the actual flammability requirements in Federal Aviation Regulation part 25 is provided. ESA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N90-29338# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.
ANALYSIS, DESIGN AND SYNTHESIS METHODS FOR GUIDANCE AND CONTROL SYSTEMS
C. T. Leondes, ed. (California Univ., Los Angeles.) Jun. 1990 489 p Original contains color illustrations
(AGARD-AG-314; ISBN-92-835-0566-2) Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The field of modern guidance and control systems has been raised to a very high level of capability because of the powerful high technology advances of the past several decades. This NATO AGARDograph captures the spirit of these powerful capabilities. Topics include integrated guidance and control systems; NAVSTAR/GPS Systems; optical gyroscope and control systems; integrated communication and navigation systems; integrated navigation flight control systems; civil aircraft navigation and traffic control; and land navigation systems. For individual titles, see N90-29339 through N90-29377.

N90-29339# Navstar Systems Development, Monument, CO.
GPS INTEGRITY REQUIREMENTS FOR USE BY CIVIL AVIATION
Alison K. Brown *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 12 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

At the request of the Federal Aviation Administration (FAA), the Radio Technical Commission for Aeronautics (RTCA) established the Special Committee 159 on September 20, 1985. The purpose of SC-159 was to prepare a Minimum Aviation System Performance Standard (MASPS) for the operation and use of the evolving Global Positioning System (GPS) in civil air navigation. To assist in preparing the MASPS, SC-159 formed an Integrity Working Group to investigate and report on civil integrity problems relating to GPS. The purpose was to establish GPS integrity monitoring requirements and to discuss suitable integrity monitoring techniques for civil aviation. The Integrity Working Group recommendations to SC-159 are summarized. Author

N90-29340# Northrop Corp., Norwood, MA. Precision Products Div.
INTEGRATION OF GPS AND STRAPDOWN INERTIAL SUBSYSTEMS INTO A SINGLE UNIT
David Buechler and Michael Foss *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 13 p Previously announced in IAA as A88-17329 (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Most Global Positioning System (GPS) receivers are designed for stand-alone operation. Single-channel, slow-sequencing receivers are recognized to be the lowest cost, but lack dynamic capability, while multiplexed and multichannel designs allow operation during acceleration, but add cost, weight and power. It is also well recognized that a marriage of GPS data with strapdown inertial data enhances the quality of both, and many people are looking at integration of available GPS receivers with various available inertial systems. However, direct design at the outset of a tightly integrated GPS and strapdown INS allows optimization of both for performance and cost. Using this approach, a properly designed slow-sequencing, single-channel receiver, married to a low-cost strapdown inertial unit, provides satellite tracking during 10-g acceleration, very high jamming suppression, improved strapdown inertial outputs, and improved GPS navigation accuracy. Packaging this GPS/I in a single unit reduces software and hardware redundancies, and results in a very low-cost design. Author

N90-29341# McDonnell Aircraft Co., Saint Louis, MO.
APPLICATION OF MULTIFUNCTION INERTIAL REFERENCE SYSTEMS TO FIGHTER AIRCRAFT
Carlos A. Bedoya and John M. Perdzock (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.) *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 33 p (For primary document see

N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

As requirements for Flight Control, Fire Control, Propulsion Control and Navigation Systems are developed for future fighter aircraft, reliability, maintainability, availability, redundancy, and survivability become key issues. These systems require dependable and accurate sources of inertial measurement data. The Multifunction Flight Control Reference System (MFCRS) was developed to demonstrate the use of a minimum number of inertial sensors. The MFCRS Program used two extensively modified Ring Laser Gyro (RLG) navigation units to perform the flight control reference and navigation functions on board an F-15 fighter aircraft. An overview is given of the various stages of development that were completed on this program, the lessons learned to date, and what is planned for the future. Evaluation of MFCRS was undertaken to evaluate performance at the system level and evaluate flight control outputs, redundancy management, electronic MRU to MRU alignment, reaction time, navigation performance, performance under vibration, temperature, EMI environments, and operation when integrated with the F-15 Flight Control System. Following the MFCRS laboratory evaluation a ground structural mode interaction test and a two phase flight test program was performed. Subsequent to the successful completion of the phase two flight test evaluation, changes to the MFCRS hardware and software structure, which would improve system performance and expand the MFCRS flight envelope, were identified. Following the laboratory evaluation additional flight testing was planned to verify that the EMFCRS configuration would result in level 1 handling qualities in both supersonic and subsonic flight was well as in tracking of target aircraft. Unfortunately, during ground testing prior to flight, a 22 Hz structural mode interaction was found in the control system pitch channel. The system changes developed during the EMFCRS studies, the laboratory test results, and the aircraft testing are discussed, as well as the follow on development of multifunction system now in process under the name of Ada Based Integrated Controls System (ABICS) Phase 3. Author

N90-29342# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.
KALMAN FILTER FORMULATIONS FOR TRANSFER ALIGNMENT OF STRAPDOWN INERTIAL UNITS
Alan M. Schneider *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 11 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Formulations of Kalman filters are presented which are capable of aligning one strapdown inertial sensor assembly with another by estimating the misalignment angle between them. One formulation treats the case of a fixed misalignment. Another treats the case of a dynamic misalignment, caused, for example, by bending of the common supporting body. Measurements can be made by gyros only, or by gyros plus accelerometers. Filters which estimate inertial sensor error parameters are also discussed. Author

N90-29343# Trimble Navigation, Sunnyvale, CA.
COMBINING LORAN AND GPS: THE BEST OF BOTH WORLDS
Paul Braisted, Ralph Eschenback, and Anil Tiwari *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 4 p Previously announced in IAA as A87-13544 (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The use of the current Loran-C network and the future GPS for marine navigation is described, and their use in combination (now planned for the period before GPS becomes fully operational in 1988) is shown to offer significant advantages over either system alone. Loran provides GPS initialization and continuous coastal coverage when GPS is out of sight, while GPS improves Loran by aiding cycle selection, ambiquity treatment, and ASF-factor calibration. Graphs and diagrams are included. Author

N90-29344# Singer Co., Wayne, NJ. Electronic Systems Div.
THE INTEGRATION OF MULTIPLE AVIONIC SENSORS AND TECHNOLOGIES FOR FUTURE MILITARY HELICOPTERS
Albert J. Shapiro *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 20 p Previously announced in IAA as A83-40301 (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The expanding role of the helicopter in the battlefield environment has burdened the pilot with missions of greater complexity and risk with a concomitant increase in pilot workload. Navigation of the helicopter is an essential supportive element to the prime mission and has been until recent years, a significant contributor to the workload. Technological advances in navigational electronics such as Doppler navigation radar, computers, integrated avionic control and display systems, etc., now can provide automated navigation with vital benefits in cost, size, weight and power, which permit incorporation of these advances into the helicopter. Cost reductions are particularly important since helicopters are used in large quantities in modern military forces. Multisensor navigation systems already available and in use in helicopters are discussed, followed by a review of the system trade-offs and considerations leading to new systems that use more advanced digital electronic techniques to achieve the goals of reduced pilot workload and improved performance with minimum size, weight, and cost. The beneficial impact of ongoing technological advances in improving the operating capabilities of future avionics systems is indicated. Author

N90-29345# Stanford Univ., CA.
TECHNIQUES FOR AUTONOMOUS GPS INTEGRITY MONITORING
Bradford W. Parkinson and Penina Axelrad *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 18 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The use of GPS for navigation critical applications such as aircraft non-precision approach or harbor and river crossings requires the navigation data to be both extremely accurate and extremely reliable. Various approaches to GPS integrity checking, are outlined, and a method is described for user autonomous satellite failure detection and isolation (D/I). The test statistic for the D/I algorithm is the range residual parameter based on six or more satellites in view. The nominal pseudo range measurement errors are modeled as normally distributed with mean in the range of -5m to +5m and standard deviation of 0.4 m based on experiments conducted at Stanford. The theoretical statistical distribution of the range residual is given. Monte Carlo simulations present results of applying the algorithm to measurement sets containing a biased measurement. With a 100 m biased measurement present successful detection is achieved 99.9 percent of the time, and successful detection and isolation is achieved 72.2 percent of the time. The user is always aware when isolation is not possible. User positioning errors resulting from application of the algorithm are always the same or better than the all in view solution. Author

N90-29346# Interstate Electronics Corp., Anaheim, CA.
MODULAR DIGITAL GPS RECEIVERS
J. Scott Graham, Peter C. Ould, and Robert J. VanWechel *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 12 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The modular digital approach to GPS receiver design being implemented at Interstate Electronics Corporation (IEC) for various range instrumentation and military P-code applications are described. The receiver consists of a preamplifier, RF downconverter that converts the GPS signal spectrum to baseband and digitizes it; single or multiple digital tracking processors for carrier and code tracking; a receiver control and navigation processor; and various types of flexible modular interface (FMI) boards. This receiver is IEC's third generation P-code design and has been achieved by a graceful miniaturization process that utilizes currently available low risk technology to reduce size, power consumption, and cost. Recent anti-jamming test results are presented. Author

N90-29347# Diesel Computing Systems, Inc., Woodland Hills, CA.

INTEGRATION OF GPS/INS WITH PARTITIONED FILTERS

John W. Diesel *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 15 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The optimal integration of a strapdown Inertial Navigation System (INS) with a Global Positioning System (GPS) in a maneuvering vehicle is considered, assuming the GPS will eventually be jammed. To achieve optimal performance after jamming, many inertial instrument errors should be calibrated by the GPS. Instead of using a single, high order Kalman filter a more effective solution is obtained by using several partitioned, low order filters. This solution is also applicable to other GPS/INS integration problems. The observation information used in these filters comes from the phase-locked GPS carrier tracking loops. Inertial rate-aiding of these loops to delay loss of lock due to jamming is investigated. This is a more difficult problem than early investigators anticipated. It is solved by partitioning each tracking loop into a high bandwidth extrapolator for upgrading the inertial aiding information and an aided low bandwidth tracking loop for tracking the GPS phase. To gain insight into these partitioned filters, a general class of Kalman filtering problems is investigated. In most cases, an analytic solution to both the transient and steady-state Kalman filter gains is obtained. These solutions can be implemented directly in the partitioned filters, rather than using real-time Kalman filters. Author

N90-29348# Aerospace Corp., El Segundo, CA.

THE 2-D AND 3-D CHARACTERIZATIONS OF GPS NAVIGATION SERVICE

P. Massatt, W. Rhodus, and K. Rudnick *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 15 p Previously announced in IAA as A87-41401 Original contains color illustrations (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The quality of world-wide GPS navigation service is frequently described by plotting on a world map background 2-dimensional regions (latitude, longitude) on the Earth's surface where navigation is degraded for some period of time, over the span of a day. Such depictions provide little information concerning when such navigation degradations occur or their duration. Computationally efficient algorithms are presented for computing the locations in space and time of these navigation degradations. Quick geometric formulas are presented for calculating the dilutions of precision. A data base is generated with this approach on a mainframe computer and then post-processed on a high resolution color graphics workstation to produce 3-dimensional plots (latitude, longitude, and time) which insightfully characterize GPS navigation service and its evolution in time. Degradation regions are readily isolated with their time of occurrence, duration, and location clearly defined. Also given are 2-dimensional plots which display location and time of poor coverage permitting an analysis of the quality of coverage from another perspective. Results are provided for the current 7 operational Block 1 satellites, a 9 satellite constellation projected for 1989 when 4 Block 2 SVs will have been added, the GPS baseline 21 SV constellation, and a revised 21 SV constellation under consideration. Author

N90-29349# Kongsberg Vapenfabrikk A/S (Norway).

APPLICATIONS OF DIFFERENTIAL GPS

Kjell Hervig and Hermod Fjaereide *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 6 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Kongsberg Navigation has developed a system for use of differential Global Positioning System (GPS) for the Norwegian offshore industry. The principles of operation and the service offered to customers of Differential GPS are described. It also describes some of the experiences with the introduction of the service, and prospects foreseen when the system is fully operational. Author

N90-29350# Naval Air Development Center, Warminster, PA.

AN ANALYSIS OF GPS AS THE SOLE MEANS NAVIGATION SYSTEM IN US NAVY AIRCRAFT

George Loewenstein, John Phanos, and Edward C. Rish (Synetics Corp., Vienna, VA.) *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 8 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The Department of Defense (DOD) is developing the Global Positioning System (GPS) to acquire a worldwide navigation capability. This satellite based system provides appropriately equipped users with precision three dimensional position and velocity, and precise time. The current edition of the U.S. Federal Radionavigation Plan, issued in 1984, presents a consolidated Federal plan on the management of those Radionavigation systems which are used by both the civilian and military sectors. It states the DOD goal to phase out the use of TACAN, VOR/DME, OMEGA, Loran C and TRANSIT in military platforms and for GPS to become the standard radionavigation system for DOD. This would eliminate all the current sole means air navigation systems (TACAN and VOR/DME) aboard military aircraft. Instrument Flight Rule (IFR) operations within controlled airspace requires an operating sole means air navigation system to be aboard the aircraft. The requirements are investigated for GPS certification as a sole means air navigation system in the U.S. National Airspace System (NAS), the implication are discussed for GPS User Equipment (UE) hardware and software, the actual UE implementation and approaches for UE integration with flight instruments on Navy aircraft are described. Author

N90-29351# Phillips (Alan H.), Syosset, NY.

THE DETERMINATION OF PDOP (POSITION DILUTION OF PRECISION) IN GPS

Alan H. Phillips *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 4 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

PDOP (Position Dilution of Precision) is defined, and equations are given to calculate it. Equations are given for 3-dimensional Global Positioning System (GPS) fixes, 2-dimensional GPS fixes, 2-dimensional hyperbolic fixes (Loran), and 2-dimensional range-range fixes. A method is given for geometrical determination of PDOP. The method gives an insight, which is lacking in the purely mathematical determination. Practical examples are given,

and the results of the geometric determination are shown to agree with the purely mathematical determination. An equation is given for a dilution factor which applies to determination of velocity; it is not the same as PDOP. Author

N90-29352# Litton Guidance and Control Systems, Woodland Hills, CA. Optical Technology Div.

RING LASER GYRO PRINCIPLES AND TECHNIQUES

Graham J. Martin *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 13 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The ring laser gyroscope (RLG) represents a departure from the mechanically based inertial rotation sensor used since the turn of the century. Since their use in the first crude gyroscopes manufactured for gun platforms at sea before the first World War, these systems have been highly refined to give the compact, accurate and relatively cost effective systems of today. The RLG offers true strapdown capability and has no known sensitivity to high g fields. Other attractive features include almost instant turn-on performance and a very linear scale factor over a very large dynamic range. Development of the RLG started in the early 1960's with the first flight tests being performed in the early 1970's. Commercial RLG-based inertial guidance systems have been available for about a decade, however the device has perhaps yet to reach its full potential. The ring laser gyro is one configuration in a class of optical gyroscopes, all of which are based on a relativistic principle known as the Sagnac Effect. The Sagnac Effect is described briefly and how it may be used to build optical rotation sensors is outlined. The RLG is placed in perspective with other forms of optical gyroscope and the basic layout is described. Details are given of the more serious error sources, such as frequency locking, and the most common means for minimizing them. In particular the lockin reduction scheme known as mechanical dither is explained. Finally an alternative form of the RLG known as the multioscillator is outlined as a possible configuration for systems where the mechanical dither approach may have shortcomings. Author

N90-29353# Litton Guidance and Control Systems, Woodland Hills, CA.

INERTIAL GRADE FIBER GYROS

G. A. Pavlath *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 12 p Previously announced in IAA as A88-51709 (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Fiber gyros are being developed for numerous applications by many people around the world. These applications include smart munitions, tactical missiles, attitude and heading reference systems (AHRS), inertial navigation, and tracking and pointing. Existing methods which were developed for achieving inertial navigation grade performance in fiber gyros are reviewed. Recent data obtained at Litton on an engineering development model of an inertial grade fiber gyro will also be presented. Author

N90-29354# Singer Co., Little Falls, NJ. Guidance and Navigation Div.

USE OF A THREE-AXIS MONOLITHIC RING LASER GYRO AND DIGITAL SIGNAL PROCESSOR IN AN INERTIAL SENSOR ELEMENT

Donald J. Weber *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 6 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A configuration based upon a 24-cm path length TRILAG gyro, three miniature single-axis force rebalance accelerometers, and a digital signal processor is presented. The resulting inertial sensor element provides navigation performance equal to a conventional medium-accuracy navigation system (0.4 to 1 nmi/h) with half the weight and volume of a traditional Ring Laser Gyro (RLG) configuration. Its application as a stand-alone inertial subsystem or as an integral part of a full inertial navigation system is discussed and performance data presented. Companion development utilizing down-sized TRILAG gyros for tactical missile or sensor stabilization applications is also reviewed. Author

N90-29355# Litton Guidance and Control Systems, Woodland Hills, CA.

RING LASER GYRO MARINE INERTIAL NAVIGATION SYSTEMS

Clinton C. Remuzzi *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 8 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The NATO navies currently use gimbaled spinning wheel gyros to support their inertial navigation system requirements. Ring Laser Gyros (RLGs) are now being considered for the next generation of marine inertial navigators. RLGs are expected to provide better performance (longer extrapolation intervals between resets), higher reliability, and lower cost-of-ownership. The performance improvement expected from RLGs was already demonstrated at sea during prototype system tests conducted by the U.S. Navy. The final production design of an RLG marine inertial navigation system (INS) required that tradeoffs be made among the sometimes conflicting factors of performance, reliability, and environmental isolation. Some of the considerations and tradeoffs involved in the design of the Litton marine RLG INS are described. Author

N90-29356# TRW Defense and Space Systems Group, San Diego, CA. Military Electronics and Avionics Div.

DISTRIBUTED CONTROL ARCHITECTURE FOR CNI PREPROCESSORS

V. R. Subramanyan and L. R. Stine *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 5 p Previously announced in IAA as A88-34056 (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Next-generation avionics systems need to incorporate extensive integration, including the Communication, Navigation, and Identification (CNI) functions. An important element in such a highly integrated CNI system is a set of programmable preprocessors, each of which can process baseband outputs from a receiver to perform real-time signal dependent processing, such as matched filtering, PN despreading, code and carrier tracking, phase rotation, correlation, convolution, pulse shape discrimination, threshold crossing, time-of-arrival detection, demodulation message formatting, and on-line status reporting. Control of the total integrated CNI system is characterized by a distributed-control architecture, wherein the execution times range from seconds at the data processor level down to a few nanoseconds at the preprocessor level. Any candidate control architecture for the preprocessor must support reprogrammability, flexibility in event scheduling, and testability, while fully meeting the requirements of each CNI function. A distributed-control architecture is described for a generic CNI preprocessor that meets the above requirements. Author

N90-29357# Hughes Aircraft Co., Fullerton, CA.

JTIDS RELATIVE NAVIGATION: PRINCIPLES, ARCHITECTURE, AND INERTIAL MIXING

W. R. Fried *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 11 p (For primary document see N90-29338 24-04)

Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals

requests available only from AGARD/Scientific Publications Executive

The time-synchronous nature and excellent time-of-arrival (TOA) measurement accuracy of the Joint Tactical Information Distribution System (JTIDS) gives rise to its inherent capability to provide high accuracy relative and absolute navigation information to vehicles carrying JTIDS terminals. This is accomplished through the inclusion of the Relative Navigation (RELNAV) software in the terminal's operational computer program. This function has been called relative navigation because it is based on passive and active ranging to the other terminals in the net. If some of these terminals have knowledge of their geodetic position (which may be true for both stationary or moving terminals), the user can determine the absolute position in standard geodetic coordinates, as well as the relative position in an arbitrarily established grid. In order to provide the highest possible accuracy for high dynamic users, the JTIDS RELNAV function is typically interconnected with a dead reckoning system on the vehicle, such as an inertial navigation system. The dead reckoning data is mixed with the JTIDS TOA data in a recursive (e.g., Kalman) filter mechanization to determine the user's position, velocity, and time bias. The principles of operation and architecture of the JTIDS RELNAV function and the system configuration for a particular inertial interconnection are described. The RELNAV observation model, and coordinate systems are discussed. Finally, some simulation results of the system are presented. Author

N90-29358# Hughes Aircraft Co., Fullerton, CA. Communications Systems Div.

PLRS: A NEW SPREAD SPECTRUM POSITION LOCATION REPORTING SYSTEM

James A. Kivett and U. S. Okawa *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 9 p (For primary document see N90-29338 24-04)
(Contract DAAB07-76-C-1750)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The Position Location Reporting System (PLRS) provides position location, tracking, and reporting for communities of hundreds of cooperating users in a tactical environment. PLRS uses time-of-arrival (TOA) measurements aided by barometric pressure measurements to establish position tracking of these large communities of user terminals. The system uses the positions of a few user terminals as grid references so that all positions are available both to the cooperating users and to command centers. All control, measurement reporting, and data exchange are cryptographically secured in a synchronous anti-jam communications network. Author

N90-29359# Hughes Aircraft Co., Fullerton, CA. Ground Systems Group.

ENHANCING PLRS WITH USER-TO-USER DATA CAPABILITY

J. A. Kivett and R. E. Cook *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 8 p Previously announced in IAA as A87-41372 (For primary document see N90-29338 24-04)
(Contract DAAB07-82-C-J096)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The Enhanced Position Location Reporting System (EPLRS) maintains all of the basic PLRS capabilities while greatly increasing the user-to-user data capability. The EPLRS utilizes the proven PLRS control network for monitoring and controlling large communities of user terminals including the positioning, position reporting, navigation aid, cryptographic key distribution, and status reporting functions. In addition, the control network is utilized for distributing communications circuit assignments and monitoring user-to-user communications performances. Both duplex (point-to-point) and group addressed (broadcast) types of service are available via the same user terminal. Each terminal can support many user circuits (needlines) simultaneously with a composite (receive plus transmit) information rate in excess of three kilobits per second. The primary user interface is via the PLRS/JTIDS Hybrid Interface (PJHI), which uses CCITT x.25 protocols, but an FSK interface is also available for backward compatibility with existing systems such as TACFIRE. The EPLRS concepts were proven through live testing using prototype terminals, including interfacing with six military host systems. In addition, extensive computer modeling and large scale user community simulation have been used to confirm extension of performance to full scale operation with up to one thousand user terminals in a division area. Limited production of over two hundred terminals is underway, with development and operational testing scheduled to begin early in 1988. Author

N90-29360# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.

OBSERVABILITY OF RELATIVE NAVIGATION USING RANGE-ONLY MEASUREMENTS

Alan M. Schneider *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 13 p Previously announced in IAA as A85-42399 Prepared in cooperation with Naval Ocean Systems Center, San Diego, CA (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A simulation tool is described which is capable of determining the observability of various fleet configurations and maneuvers in a relative navigation environment. The motion of the relative grid established by the navigation controller is explicitly modeled as a function of the errors in his dead-reckoning sensors. The simulation uses centralized, optimal processing of an extended Kalman filter. Results show observability on a good geometry, with some degradation in performance when dead-reckoning sensor errors change rapidly. Author

N90-29361# Singer Co., Little Falls, NJ.

INTEGRATED STRAPDOWN AVIONICS FOR PRECISION GUIDED VEHICLES

Jack Richman, David Haessig, Jr., and Bernard Friedland *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 5 p Previously announced in IAA as A86-35348 (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Conventional avionic configurations for precision guided weapons are often unnecessarily costly and inefficient because of built-in (but unused) redundancy in instrumentation attributed to the present day independent systems design approach. Described in this paper is an integrated design approach using strapdown avionic components that has the potential for lowering cost, increasing reliability and improving overall performance as a result of using fewer and less costly instruments in an optimum manner. Author

N90-29362# Litton Guidance and Control Systems, Woodland Hills, CA.

INTEGRATED NAVIGATION/FLIGHT CONTROL FOR FUTURE HIGH PERFORMANCE AIRCRAFT

Robert E. Ebner and A. David Klein *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 8 p Previously announced in IAA as A88-35560 (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Litton has delivered an Advanced Development Model (ADM) of an Integrated Inertial Sensor Assembly (IISA) on contract to the U.S. Naval Air Development Center. IISA is designed to provide all inertial sensor needs for modern military aircraft, including flight control and navigation, with reduced avionics cost through the

use of redundant skewed inertial navigation sensors. Various design aspects of using six ring-laser gyros and six inertial-grade accelerometers in two, separated clusters are described. The redundancy management mechanization and the system design features for maximum flight safety are given. Navigation performance limits of strapdown INS, including the effects of skewed sensors, are presented. Laboratory testing will be performed by the Navy and flight testing will be conducted on an F-15 as part of a joint Navy/Air Force program. Author

N90-29363# McDonnell Aircraft Co., Saint Louis, MO.
SURVIVABLE PENETRATION
Carlos A. Bedoya, Gary N. Maroon, William J. Murphy, and Charles W. Chapoton (Texas Instruments, Inc., McKinney.) *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 34 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Threat densities expected on a modern battlefield do not allow penetrating tactical aircraft the option of simply flying around individual threats. As the threat becomes even more sophisticated in the 1990s new aircraft avionic systems will need to be fielded that will enable survivable penetration of tactical aircraft in an even more lethal threat environment. Recent advances in onboard mission planning, navigation, and terrain following/terrain avoidance/threat avoidance (TF/TA/TA) technologies and the onboard availability of stored digital terrain data enable the mechanization of such a survivable penetration capability. Onboard mission planning constructs a survivable penetration reference corridor which takes into account terrain data, the location of known threats, the expected densities of unknown and mobile threats, and mission goals. An advanced aided navigation capability, using information from the global positioning system, aiding sensors such as radar, and terrain navigation features, is necessary to make maximum use of the onboard terrain data. The TF/TA/TA function computes flyable three-dimensional paths within the reference corridor accounting for aircraft performance limits, knowledge of the surrounding terrain, and information about the threat. All three technologies use the Defense Mapping Agency's Digital Land Mass System (DLMS) terrain to provide look-ahead terrain masking and aided navigation. Through this survivable penetration methodology, advanced tactical aircraft can have enhanced aircraft survivability. Author

N90-29364# Mitre Corp., McLean, VA.
INDEPENDENT GROUND MONITOR COVERAGE OF GLOBAL POSITIONING SYSTEM (GPS) SATELLITES FOR USE BY CIVIL AVIATION
Karen J. Viets *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 8 p (For primary document see N90-29338 24-04)
(Contract DTFA01-84-C-00001)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The Federal Aviation Administration plans to independently monitor signals-in-space from the Global Positioning System (GPS) for the purpose of providing immediate awareness to civil aviation users of the operational status of GPS when it is used in the National Airspace System. The operational status will be disseminated to Air Traffic Control and will possibly be broadcast from ground monitoring stations to GPS aviation users via a dedicated integrity channel. An algorithm is described that measures the coverage of a configuration of ground monitoring station locations, and applies the algorithm to several different configurations of ground monitoring stations to compare the coverage provided. Also included are the resulting ground monitoring station configurations that provide the best coverage of GPS signals for several specific geographical areas, the conterminous United States (CONUS), Canada, and Alaska. Author

N90-29365# Mitre Corp., McLean, VA. Metrek Div.
ANALYSIS OF THE INTEGRITY OF THE MICROWAVE LANDING SYSTEM (MLS) DATA FUNCTIONS
M. B. El-Arini and M. J. Zeltser *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 14 p Previously announced in IAA as A87-41388 (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The Microwave Landing System (MLS) transmits angle, data, and range information for use by airborne receivers. The integrity of the data functions is analyzed in terms of the probability of undetected errors remaining in the data. The data format and integrity requirements were derived from the MLS standards and guidance material defined by the International Civil Aviation Organization (ICAO). Results show that the performance requirements can be met by: (1) averaging the received data bits of several samples of the same word using a majority voting; (2) reducing the bit error rate at the output of the receiver's decoder; and (3) a combination of the above techniques. Author

N90-29366# Litton Guidance and Control Systems, Woodland Hills, CA.
FAULT DETECTION AND ISOLATION (FDI) TECHNIQUES FOR GUIDANCE AND CONTROL SYSTEMS
Mark A. Sturza *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 13 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Fault Detection and Isolation (FDI) techniques are described with particular emphasis on strapdown inertial system and Global Positioning System (GPS) applications. A generalized measurement model is considered with a single fault, step bias shift fault model. The parity vector is developed and analyzed. Equivalence is established between the parity and innovations approachs to FDI. A fault detection technique based on the parity vector is presented and analyzed. The Probabilities of False Alarm (P sub FA) and Missed Detection (P sub MD) are derived. The Detector Operating Characteristic (DOC) relating these probabilities is constructed. DOCs are presented for several inertial sensor and GPS satellite configurations. A maximum likelihood fault identification technique is described. A nonparity approach to FDI analysis is presented. The final section lists areas for future work. Author

N90-29367# Northrop Corp., Hawthorne, CA. Electronics Div.
CONTROL AND ESTIMATION FOR AEROSPACE APPLICATIONS WITH SYSTEM TIME DELAYS
Edward J. Knobbe *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 5 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In many practical aerospace applications, guidance and control accuracy is significantly degraded as a result of system transport lags (or time delays). Historically, solutions to problems of this type were required when significant digital computer data delays were encountered or when human operators (e.g., aircraft pilots) became an integral part of the closed-loop operation. More recently, this type of problem is encountered in current SDI (Strategic Defense Initiative) related problems such as laser beam pointing and tracking and, atmospheric laser beam wavefront correction. The problem of controlling a linear discrete-time system where both the measured output and the process evolution are functions of time-delayed states is assessed. The optimal control solution is developed by re-casting the original system representation, with explicit time-delayed states, into a standard regulator form using state vector augmentation. Practical considerations are discussed regarding the implementation of this control law. This solution

should prove useful in this and other advanced aerospace applications where system time delays are present and where precision guidance and control is required. Author

N90-29368# Analytic Sciences Corp., Reading, MA.
OVERVIEW OF OMEGA SIGNAL COVERAGE
Radha R. Gupta and Peter B. Morris (Omega Navigation System Center, Alexandria, VA.) *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 18 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Successful use of the Omega Navigation System requires external information on the system coverage (i.e., spatial and temporal accessibility of usable signals from the Omega system) in selecting Omega signals for position fix computations. The published Omega signal coverage information is reviewed and the type (and basis) of the coverage information currently disseminated by the U.S. Coast Guard Omega Navigation System Center described. Assessments of the worldwide coverage provided by the system, and the impact of Omega transmitting station outages on the system coverage are also given. Author

N90-29369# Omega Navigation System Center, Alexandria, VA.
OMEGA NAVIGATION SIGNAL CHARACTERISTICS
Peter B. Morris and Radha R. Gupta (Analytic Sciences Corp., Reading, MA.) *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 14 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A description of Omega/VLF signal propagation is given. Particular emphasis is given to nonstandard signal propagation scenarios including propagation over regions of low ground conductivity, signal spreading and converging, antipodal effects and long-path reception, modal interference (including fast terminator transit and off-path effects), and temporal anomalies (SIDs, PCAs, and magnetic storms). These elements of signal behavior are described qualitatively to aid in understanding the basis for signal selection algorithms employed in conventional Omega/VLF receiving systems. Equipped with this knowledge, the user may invoke manual deselection procedures when the receiver is suspected of processing an undesirable signal, i.e., likely to produce significant navigational error. As further guidance, a table of recommended signal deselections is given for approximately 80 geographic locations around the Earth. Signals are recommended for deselection on the basis of modal interference, long-path reception, and solar proton activity. Author

N90-29370# Aerospace Corp., Los Angeles, CA.
POINTING CONTROL SYSTEM FOR THE TEAL RUBY EXPERIMENT
Ron Rogers and Monte Schlessinger *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 9 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Teal Ruby is an advanced Earth-orbiting sensor that was developed to demonstrate the ability to detect airborne vehicles from space by use of infrared mosaic technology. The pointing system, which is able to direct the sensor at any designated target within the pointing envelope constraints and hold it steady with very low drift and jitter, represents a substantial increase in capability over earlier spaceborne systems. This pointing system, and the approach objectives, are examined. Author

N90-29371# GEC Avionics Ltd., Rochester (England). Guidance Systems Div.
THE POTENTIAL FOR DIGITAL DATABASES IN FLIGHT PLANNING AND FLIGHT AIDING FOR COMBAT AIRCRAFT
J. Stone *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 10 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The forces opposing the NATO alliance are constantly improving their capability in the detection, location and interception of attacking aircraft. The ground attack pilot's survival depends upon his ability to conceal his approach by minimizing his aircraft signature in all visual, thermal, acoustic and electronic aspects. In attempting to achieve this, the pilot is forced to fly at altitudes and periods of the day which make the very essence of his mission most difficult to accomplish. From this background has emerged the general concept of stealth. The introduction of passive electro optical sensors in the form of FLIR and NVGs has been a significant step forward in aiding the combat pilot in this hostile environment. TF radars enable low level flight in all weathers. However, the FLIR/NVG combination is not all weather and TF radars are not stealthy. Recent developments in data storage, advanced processing techniques and highly efficient display presentation have been instrumental in enabling covert operations to take place in all weathers. Precise autonomous navigation and terrain following, with the threat of detection minimized, is now available to the modern combat pilot, freeing him to concentrate on successfully achieving the aims of his mission. The potential for digital databases in Flight Planning and Flight Aiding for Combat Aircraft is recognized and equipments are now being procured for military use. The capabilities described in this paper are all feasible, and are being integrated into GEC Avionics' system of Total Terrain Avionics (T sup 2A). Author

N90-29372# Westinghouse Defense and Electronic Systems Center, Baltimore, MD.
GUIDANCE AND CONTROL TECHNIQUES FOR AIRBORNE TRANSFER ALIGNMENT AND SAR MOTION COMPENSATION
James L. Farrell *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 6 p Previously announced in IAA as A88-35558 (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A synthetic aperture radar employing an electronically steerable array antenna is simulated for the case of an existent master inertial measuring unit (IMU) in a remote location. To obtain reliable motion compensation data a strapdown IMU is mounted within about a foot of the antenna. Ramifications include (1) the approach to transfer alignment, (2) nav update for the master IMU, and (3) effects of motion-sensitive strapdown inertial instrument degradations on synthetic aperture radar (SAR) mode performance. These ramifications are addressed; although results are presented for simulation under simplified conditions only, the path was prepared for full operational validation as discussed. Author

N90-29373# Massachusetts Univ., Amherst.
STATE ESTIMATION FOR SYSTEMS MOVING THROUGH RANDOM FIELDS
Donald E. Catlin and Robert L. Geddes (Analytic Sciences Corp., Reading, MA.) *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 16 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A growing memory discrete dynamic model for performing temporal extrapolations along a predetermined path in a random field is presented. This dynamic model is used to drive a linear system that is itself driven by discrete white noise. The coupled system is used to derive a state estimation scheme that recursively processes noisy measurements of the system. In addition, using the aforementioned dynamic model as a reference (truth) model, a covariance analysis was developed to measure the estimation

errors that occur when the dynamics along the path through the field are modeled as a Markov linear model and state estimation is performed using discrete Kalman filtering. The performance evaluation of an inertial navigation system influenced by the Earth's gravity field aboard a maneuvering ship is provided as a specific illustrative example. Author

N90-29374# GEC Avionics Ltd., Rochester (England). Guidance Systems Div.
A LOW COST INERTIAL/GPS INTEGRATED APPROACH TO LAND NAVIGATION
D. G. Harris *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 7 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The positional accuracy obtainable from the Global Positioning System (GPS) is much better than any preceding system and at a comparatively modest cost. This enables vehicles fitted with GPS receivers to be much more effective in operation and deployment. But to take full advantage of this accuracy, it is necessary that the navigation data is continuously available to the vehicle crew. While GPS is designed to be resistant to jamming it would be imprudent to assume that no significant periods of jamming will occur on the battlefield. One solution which provides continuous data is to use a hybrid system combining GPS and a low performance Inertial Navigation System (INS). Data from these systems is combined in a statistical (Kalman type) filter. This arrangement provides continuous data with no discontinuity of values, and redundancy to mitigate the effects of equipment failure. The likely accuracy requirements for land navigation systems and ways in which these can be met with a low cost hybrid system are reviewed. The results of the analysis of such a system, using test data from a low cost INS are included, demonstrating the effect of various GPS jamming patterns. Author

N90-29375# Sandia National Labs., Albuquerque, NM.
A LAND NAVIGATION DEMONSTRATION VEHICLE WITH A COLOR MAP DISPLAY FOR TACTICAL USE
E. J. Nava, E. E. Creel, J. R. Fellerhoff, and S. D. Martinez *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 9 p Sponsored in part by Army Avionics Research and Development Activity, Fort Monmouth, NJ (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A Land navigation Demonstration Vehicle (LDV) was assembled which fully automates the navigation task and provides the operator with a color map display derived from Digital Terrain Elevation Data (DTED). The system relieves the operator of the burdens associated with the tactical use of paper maps by providing accurate 3-dimensional position information using a strapdown inertial navigation platform aided by the Sandia Inertial Terrain Aided Navigation algorithm (SITAN). The map display and navigation instruments consist of a multi-processor SANDia Aerospace Computer (SANDAC) and a commercial Image Processing System (IPS). These interactive devices allow real-time map annotation and corrections of vehicle position errors. Author

N90-29376# General Motors Technical Center, Warren, MI. Advanced Engineering Staff.
SATELLITE NAVIGATION SYSTEMS FOR LAND VEHICLES
Ronald A. Dork and Oliver T. McCarter *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 7 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Today's motorists often must confirm their route by referring to a roadmap. Looking at a map while driving creates a poor traffic situation, one even more acute for drivers of emergency service vehicles. To address this problem, development engineers at the General Motors Technical Center and Delco Electronics integrated an experimental GPS receiver into a GM Buick Park Avenue. The receiver is designed to acquire and sequentially track signals from four satellites. The vehicle's precise latitude, longitude, and altitude are determined and presented on a color cathode ray tube (CRT) map display in the car's instrument panel. Author

N90-29377# Defence Research Establishment, Ottawa (Ontario).
AN INTEGRATED SYSTEM FOR LAND NAVIGATION
J. C. McMillan *In* AGARD, Analysis, Design and Synthesis Methods for Guidance and Control Systems Jun. 1990 20 p (For primary document see N90-29338 24-04)
Copyright Avail: NTIS HC A21/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Conditions for land navigation are among the most severe in the arctic, where until Global Positioning Systems (GPS) becomes fully operational, there will be no single system capable of continuously providing the necessary position and heading accuracy. Even when GPS is available reliability considerations will dictate that a self contained or autonomous backup be available, certainly for the military user. The Defence Research Establishment Ottawa (DREO) has therefore developed a multi-sensor optimally integrated navigation system to satisfy the present operational requirements of the Canadian land forces. This system, called PLANS (Primary Land Arctic Navigation System) was designed and built to be a highly reliable, moderately accurate and moderately priced, nonradiating, automatic navigation system for all weather off the road use. Although designed primarily to meet an arctic requirement, PLANS would of course be just as applicable for desert navigation, or for any application in which reliability and accuracy are a priority, or where simpler and less costly methods are ineffective. PLANS combines several self contained sensors with two satellite receivers, using an 8 state Kalman filter on a 68000 based microcomputer, to provide a continuous optimal estimate of position, height and heading. The self contained sensors consist of a strapdown gyrocompass/directional gyro unit, an odometer pickoff for speed, a magnetic fluxgate sensor (with a detailed geomagnetic field model in the software) and a baroaltimeter (with a digital terrain elevation map providing assistance). The satellite receivers are a single channel C/A code GPS and dual channel Transit. This section will describe the requirement, the difficulties in meeting this requirement, the design of a multi-sensor integrated system solution, some simulation results and some field trial results. Author

N90-29378 Rice Univ., Houston, TX.
OPTIMAL TRAJECTORIES FOR HYPERVELOCITY FLIGHT
Ph.D. Thesis
Woon Yung Lee 1989 99 p
Avail: Univ. Microfilms Order No. DA9012824

Optimal trajectories are discussed for hypervelocity flight of interest in aeroassisted orbital transfer. Both coplanar orbital transfer and noncoplanar orbital transfer are studied. For these cases, the GEO-to-LEO transfer, the HEO-to-LEO transfer, and the LEO-to-LEO transfer are considered in connection with a spacecraft which is controlled during the atmospheric pass via the angle of attack (coplanar case) or via the angle of attack and the angle of bank (noncoplanar case). For the noncoplanar case, three transfer maneuvers are studied. Type 1 involves four impulses and four space plane changes; Type 2 involves three impulses and three space plane changes; and Type 3 involves three impulses and no space plane change. In Type 1, the initial impulse directs the spacecraft away from Earth, and then is followed by an apogee impulse propelling the spacecraft toward Earth; in Types 2 and 3, the initial impulse directs the spacecraft toward Earth. A common element of these maneuvers is that they all include an atmospheric pass, with velocity depletion coupled with plane change. Within the framework of classical optimal control, the following problems are studied: (P1) minimize the energy required for orbital transfer;

(P2) maximize the time of flight during the atmospheric portion of the trajectory; and (P3) minimize the time integral of the square of the path inclination. Within the framework of minimax optimal control, the following problem is studied: (P4) minimize the peak heating rate. Numerical solutions for Problems (P1), (P2), (P3), (P4) are obtained by means of the sequential gradient-restoration algorithm for optimal control problems. The engineering implications of the results obtained are discussed. In particular, it is shown that the nearly-grazing solution is a useful engineering compromise between energy requirements and aerodynamic heating requirements. Dissert. Abstr.

N90-29379# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
INERTIAL NAVIGATION SYSTEM SIMULATOR PROGRAM: TOP-LEVEL DESIGN Final Report
Kenneth J. Fowler Jan. 1990 59 p
(Contract F19628-89-C-0003)
(AD-A223762; CMU/SEI-89-TR-38; ESD-TR-89-49) Avail: NTIS HC A04/MF A01 CSCL 17/7

Hard real time systems have consistently proven to be some of the most difficult for successful software implementation. Attributes often associated with the intractable nature of real time are concurrency, severe timing constraints, the complexity of real-world devices, and limited resources. An actual embedded hard real time application (Inertial Navigation Set, AN/WSN-5) is simulated and ported to a variety of target processors. The effort is specifically directed at investigating the capability of Ada for providing program development solutions in the hard real time regime. Special emphasis is focused on applying the built-in concurrency capabilities of Ada. The effort contends with typical cross-targeting issues such as board-level execution and memory configuration, device communications, and runtime debugging of the application. The top level design is presented of the application and the solution is addressed in terms of a concurrency abstraction. Beginning with a classical data flow analysis of the requirements, Ada tasks are derived from analyzable categories, specifically periodics, aperiodics, and servers. This classification scheme is predicted on work actively being conducted on a scheduling technique that quantifies the effect of task preemption and blocking, behavior fundamental to the concept of parallelism in Ada. GRA

N90-29380 Physics and Electronics Lab. TNO, The Hague (Netherlands).
STUDY IMPROVEMENT TRAINING FACILITIES GROUND CONTROL AIR TRAFFIC CONTROLLERS. PART 1: ALTERNATIVE SOLUTIONS AND THEIR CONSEQUENCES Final Report, Part 1, Sep. 1988 - Sep. 1989
W. G. deJong, J. C. M. Mooijekind, and G. vanderVeen Jan. 1989 60 p In DUTCH; ENGLISH summary
(Contract A88/KLu/621)
(FEL-89-A257-Pt-1; TD-89-3874-Pt-1; ETN-90-97413) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, The Netherlands

The consequences of moving the air traffic control training facilities to another location as well as possible improvements were investigated. The aim was to become independent of the operational radars of the air base to which the present simulator is linked. The problems of the present system were analyzed and a number of alternative solutions were considered. It is shown that an integration of radar simulation and target generation is preferable with a control from a computer assisted supervisor-instructor's position. The existing position approach radar consoles can be replaced by adapted workstation. ESA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles see *85 Urban Technology and Transportation*.

N90-29381*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
THE DELTA MONSTER: AN RPV DESIGNED TO INVESTIGATE THE AERODYNAMICS OF A DELTA WING PLATFORM Final Design Proposal
Kristen Connolly, Mike Flynn, Randy Gallagher, Chris Greek, Marc Kozlowski, Brian McDonald, Matt McKenna, Rich Sellar, and Andy Shearon 1989 172 p
(Contract NASw-4435)
(NASA-CR-186226; NAS 1.26:186226) Avail: NTIS HC A08/MF A01 CSCL 01C

The mission requirements for the performance of aerodynamic tests on a delta wind planform posed some problems, these include aerodynamic interference; structural support; data acquisition and transmission instrumentation; aircraft stability and control; and propulsion implementation. To eliminate the problems of wall interference, free stream turbulence, and the difficulty of achieving dynamic similarity between the test and actual flight aircraft that are associated with aerodynamic testing in wind tunnels, the concept of the remotely piloted vehicle which can perform a basic aerodynamic study on a delta wing was the main objective for the Green Mission - the Delta Monster. The basic aerodynamic studies were performed on a delta wing with a sweep angle greater than 45 degrees. These tests were performed at various angles of attack and Reynolds numbers. The delta wing was instrumented to determine the primary leading edge vortex formation and location, using pressure measurements and/or flow visualization. A data acquisition system was provided to collect all necessary data. B.G.

N90-29382 Maryland Univ., College Park.
NONLINEAR STATIC AND DYNAMIC MODELING OF COMPOSITE ROTOR BLADES INCLUDING WARPING EFFECTS Ph.D. Thesis
Alan Douglas Stemple 1989 195 p
Avail: Univ. Microfilms Order No. DA9012524

A beam finite element formulation was developed to model helicopter rotor blades constructed of composite materials. The present formulation takes into account the warping effects of composite beams undergoing large deflections. This formulation can handle static and free vibration analysis of both rotating and non-rotating composite beams. The new approach can model thin to moderately thick walled beams with complicated cross-sections, tapers, planforms and pretwists. The formulation allows transverse shear deformation. The warping displacement parallel to the beam axis in the deformed configuration is superimposed over the cross-section. The strain is assumed to vary linearly through the thickness of the wall. This allows analytical integration through the thickness direction for arbitrary ply layups. The Fixed or Total Lagrangian description is adopted for the large deflection analysis. A body fixed system is used to describe the finite rotations. The natural modes and frequencies of both rotating and non-rotating composite beams are calculated using a subspace iteration technique. A comparative study with more elaborate finite element models is presented as well as correlation with experimental observations. Many numerical tests are presented, showing various features of the present analysis. Beams involving the various structural couplings, bending-torsion, extension-torsion and extension-bending, are examined. Correlation of numerical tests with shell and three-dimensional solid element formulations, as well as experimental results, demonstrate the validity and effectiveness of the present approach. Dissert. Abstr.

N90-29383*# Analytical Services and Materials, Inc., Hampton, VA.
AN ENHANCED INTEGRATED AERODYNAMIC LOAD/DYNAMIC OPTIMIZATION PROCEDURE FOR HELICOPTER ROTOR BLADES Final Report
Aditi Chattopadhyay and Y. Danny Chiu (Lockheed Engineering and Sciences Co., Hampton, VA.) Washington NASA Oct. 1990 17 p Presented at the 46th Annual Forum of the American Helicopter Society, Washington, DC, 21-23 May 1990
(Contracts NAS1-18599; NAS1-19000)
(NASA-CR-4326; NAS 1.26:4326) Avail: NTIS HC A03/MF A01 CSCL 01C

An enhanced integrated aerodynamic load/dynamic optimization procedure is developed to minimize vibratory root shears and moments. The optimization is formulated with 4/rev vertical and 3/rev inplane shears at the blade root as objective functions and constraints, and 4/rev lagging moment. Constraints are also imposed on blade natural frequencies, weight, autorotational inertia, centrifugal stress, and rotor thrust. The 'Global Criteria Approach' is used for formulating the multi-objective optimization. Design variables include spanwise distributions of bending stiffnesses, torsional stiffness, nonstructural mass, chord, radius of gyration, and blade taper ratio. The program CAMRAD is coupled with an optimizer, which consists of the program CONMIN and an approximate analysis, to obtain optimum designs. The optimization procedure is applied to an advanced rotor as a refererence design. Optimum blade designs, obtained with and without a constraint on the rotor thrust, are presented and are compared to the reference blade. Substantial reductions are obtained in the vibratory root forces and moments. As a byproduct, improvements are also found in some performance parameters, such as total power required, which were not considered during optimization. Author

N90-29384*# Lockheed Engineering and Sciences Co., Hampton, VA.
AIRCRAFT DESIGN FOR MISSION PERFORMANCE USING NONLINEAR MULTIOBJECTIVE OPTIMIZATION METHODS Final Report
Augustine R. Dovi and Gregory A. Wrenn Washington NASA Oct. 1990 29 p
(Contract NAS1-19000)
(NASA-CR-4328; NAS 1.26:4328) Avail: NTIS HC A03/MF A01 CSCL 01C

A new technique which converts a constrained optimization problem to an unconstrained one where conflicting figures of merit may be simultaneously considered was combined with a complex mission analysis system. The method is compared with existing single and multiobjective optimization methods. A primary benefit from this new method for multiobjective optimization is the elimination of separate optimizations for each objective, which is required by some optimization methods. A typical wide body transport aircraft is used for the comparative studies. Author

N90-29385*# Technion Research and Development Foundation Ltd., Haifa (Israel).
MULTI-DISCIPLINARY OPTIMIZATION OF AEROSERVOELASTIC SYSTEMS Annual Report, 1 Oct. 1989 - 30 Sep. 1990
Mordechay Karpel 12 Sep. 1990 31 p
(Grant NAGw-1708)
(NASA-CR-185931; NAS 1.26:185931) Avail: NTIS HC A03/MF A01 CSCL 01C

Efficient analytical and computational tools for simultaneous optimal design of the structural and control components of aeroservoelastic systems are presented. The optimization objective is to achieve aircraft performance requirements and sufficient flutter and control stability margins with a minimal weight penalty and without violating the design constraints. Analytical sensitivity derivatives facilitate an efficient optimization process which allows a relatively large number of design variables. Standard finite element and unsteady aerodynamic routines are used to construct a modal data base. Minimum State aerodynamic approximations and dynamic residualization methods are used to construct a high accuracy, low order aeroservoelastic model. Sensitivity derivatives of flutter dynamic pressure, control stability margins and control effectiveness with respect to structural and control design variables are presented. The performance requirements are utilized by equality constraints which affect the sensitivity derivatives. A gradient-based optimization algorithm is used to minimize an overall cost function. A realistic numerical example of a composite wing with four controls is used to demonstrate the modeling technique, the optimization process, and their accuracy and efficiency. Author

N90-29386# Boston Univ., MA. Coll. of Engineering.
ANALYSIS OF DYNAMIC TRANSIENT RESPONSE AND POSTFLUTTER BEHAVIOR OF SUPER-MANEUVERING AIRPLANE Final Technical Report, 15 Apr. 1987 - 14 Aug. 1988
Luigi Morino and Slobodan R. Sipcic 15 Aug. 1988 69 p
(Contract F49620-86-C-0040; AF Proj. 2302)
(AD-A224126; AFOSR-90-0747TR) Avail: NTIS HC A04/MF A01

A general geometrically exact Lagrangian mechanics formulation for the aeroelastic analysis of a maneuvering aircraft is presented. The motion of the aircraft is expressed in terms of the location of the origin of the body frame of reference, the rigid body rotation of the body frame of reference, and a deformation. The Lagrangian equations of motion for the corresponding degrees of freedom were obtained. A formulation was specialized to the case of a fluttering buckled plate on an aircraft undergoing a pitching maneuver. Assuming that the maneuvering of the aircraft is prescribed, the Lagrange equations of motion for the elastic degree of freedom was derived. This equation was then used to study the response of the panel of an aircraft engaged in a pull-up maneuver. The large amplitude responses are investigated by using the digital computer. As the maneuvering (load factor) increases, systems exhibits complicated dynamic behavior including period multiplying and demultiplying bifurcations and chaos. Author

N90-29387# Dayton Univ., OH. Research Inst.
AIRCRAFT BATTLE DAMAGE REPAIR OF TRANSPARENCIES Interim Report, Oct. 1986 - Dec. 1988
Susan S. Saliba Apr. 1990 61 p Submitted for publication
(Contract F33615-86-C-5031; AF Proj. 2418)
(AD-A224168; WRDC-TR-89-4148) Avail: NTIS HC A04/MF A01 CSCL 11/4

Both induction heating and adhesive bonding techniques were used to perform rapid repairs on aircraft transparencies under 'field' conditions. Patches were applied on various plastic laminated materials and were tested both for air leak rate and structural durability (cockpit air pressure representing ground-air-ground cycles). GRA

N90-29388# Florida Univ., Gainesville. Dept. of Engineering Sciences.
HIGH ALTITUDE BALLOON FLIGHT TEST OF THE GRAD EXPERIMENT Final Report
Robert J. Hicks and David H. Jenkins Apr. 1990 1 p
(Contract N00014-87-G-0259)
(AD-A224398) Avail: NTIS HC A01/MF A01 CSCL 01/3

The responsibilities were: (1) design and construct the gondola which would carry the GRAD experiment, solar and battery power, and appropriate telemetry beneath a balloon; (2) design and build a Sun sensor which would provide input to a rotator system designed to position the gondola for accurate pointing; and (3) participate in the integrating and testing of all the equipment and systems prior to flight. GRA

N90-29389*# Kansas Univ., Lawrence. Dept. of Aerospace Engineering.
FIGHTER AGILITY METRICS M.S. Thesis
Randall K. Liefer 1990 206 p Sponsored by NASA, Dryden Flight Research Center and AFIT, Wright-Patterson AFB, OH

(NASA-CR-187289; NAS 1.26:187289; AD-A224477; AFIT/CI/CIA-90-035) Avail: NTIS HC A10/MF A02 CSCL 01/3

Fighter flying qualities and combat capabilities are currently measured and compared in terms relating to vehicle energy, angular rates and sustained acceleration. Criteria based on these measurable quantities have evolved over the past several decades and are routinely used to design aircraft structures, aerodynamics, propulsion and control systems. While these criteria, or metrics, have the advantage of being well understood, easily verified and repeatable during test, they tend to measure the steady state capability of the aircraft and not its ability to transition quickly from one state to another. Proposed new metrics to assess fighter aircraft agility are collected and analyzed. A framework for classification of these new agility metrics is developed and applied. A complete set of transient agility metrics is evaluated with a high fidelity, nonlinear F-18 simulation. Test techniques and data reduction methods are proposed. A method of providing cuing information to the pilot during flight test is discussed. The sensitivity of longitudinal and lateral agility metrics to deviations from the pilot cues is studied in detail. The metrics are shown to be largely insensitive to reasonable deviations from the nominal test pilot commands. Instrumentation required to quantify agility via flight test is also considered. With one exception, each of the proposed new metrics may be measured with instrumentation currently available. GRA

N90-29390# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
WINGDESIGN: PROGRAM FOR THE STRUCTURAL DESIGN OF A WING CROSS-SECTION
R. P. G. Zoontjes and A. Rothwell Apr. 1990 15 p
(LR-627; ETN-90-97638) Avail: NTIS HC A03/MF A01

A computer program written in FORTRAN 77 for the structural design of a wing cross section is described. The program is typically intended for use at the preliminary design stage. The wing is assumed to be of conventional metal stressed-skin construction, with two spar webs. The analysis of a proposed design may be followed by optimization for minimum weight. Easy modification of the design, and the facility to fix any of its dimensions at any stage, allows the user to remain in control of the progress of the design. The program is suitable for use on a personal computer. ESA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N90-29391# National Aerospace Lab., Tokyo (Japan). Flight Research Div.
EVALUATION FOR DLC-FLAP MONITORING SYSTEM OF THE VSRA [KAHEN ANTEI OUTOU JIKKENKI NO DLC SHISUTEMU MONITANITSUITE]
Kazutoshi Ishikawa, Takatsugu Ono, and Yukichi Tsukano Jul. 1989 20 p In JAPANESE
(NAL-TM-607; ISSN-0452-2982; JTN-90-80192) Avail: NTIS HC A03/MF A01

The movement of an airplane in the strong backside region is simulated as is the movement of the space plane at landing. There is a limit in the ability to vertically control it using only the conventional elevon and the throttle. In order to simulate the motion, the flap of the variable stability and response airplane (VSRA) is modeled by adding the DLC (Direct Lift Control) system into the VSRA system, which controls a lift directly. The installation improves the control ability of the VSRA system. However, the system is very complicated. Therefore, system monitors are designed in order to keep it safe and to make it experimentally efficient. Results from the monitor of the software of a DLC system and its components are as follows: (1) Interlock and condition monitors are designed as is most suitable for the DLC system; (2) Quadratic model including dead time is constructed for the servo-dynamic monitor; and (3) an evaluation is made by the ground and the inflight tests, and it is concluded that the monitor can be operated efficiently. NASDA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N90-29392 Cranfield Inst. of Tech., Bedford (England).
ASSESSMENT AND IMPROVEMENT OF AEROENGINE DISC STRUCTURAL INTEGRITY Ph.D. Thesis
Dong-Mei Qi 1989 414 p
Avail: Univ. Microfilms Order No. BRDX88324

Advanced design and evaluation methodologies used for the assessment and improvement of aeroengine disc structural integrity are systematically investigated. The principal objective was established after performing: an evaluation of the widely-used aeroengine disc design procedure, an assessment of the more promising Retirement-For-Cause or Damage-Tolerant-Design philosophy, and the identification of areas where improved understanding and further developments with respect to analysis procedures and tools are needed for the implementation of these new criteria. The study considers all the critical stages of discs in service including: crack free stage, crack growth stage, and final disc failure. It concentrates on the following aspects: the use of existing CAD and numerical stress analysis tools for the evaluation of disc structural integrity, the development, validation and dedicated application of numerical algorithms and programs for geometrical optimization, and fracture and fatigue predictions of aeroengine disc structures, the generation of quantitative results for stress distribution, geometrical optimization, crack initiation life, residual strength and residual life using existing and specially-developed techniques and tools, and the demonstration of the applicability of a fracture mechanics-based design and evaluation approach. Particular attention was devoted to: the stress distribution induced by the disc/blade assembly centrifugal force, geometrical optimization for reduced stress concentrations, crack initiation life predictions for critical regions of the dovetail fillet under simplified flight mission loading, structural residual strength evaluations for discs with dovetail cracks using the J-integral approach, and crack growth evaluations for discs with dovetail cracks subjected to flight-type low cycle fatigue loading. The above investigations were carried out on an aeroengine disc model provided by Rolls Royce Limited, and the optimized dovetail design obtained from the present investigations. Photoelastic stress-freezing spin tests were used to validate the finite element stress analysis-and fracture mechanics analysis-results. Dissert. Abstr.

N90-29393# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel Working Group 19.
RECOMMENDED PRACTICES FOR MEASUREMENT OF GAS PATH PRESSURES AND TEMPERATURES FOR PERFORMANCE ASSESSMENT OF AIRCRAFT TURBINE ENGINES AND COMPONENTS
H. I. H. Saravanamuttoo 1990 162 p
(AGARD-AR-245; ISBN-92-835-0499-2) Copyright Avail: NTIS HC A08/MF A01; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The results of the Propulsion and Energetics Panel Working Group 19 are summarized. It is of interest to engineers concerned with steady state testing of aircraft turbine engines and their components, and provides information on gas path pressure and

temperature measurement techniques and instrumentation. Manufacturers and research institutions throughout the world have developed their own practices for measurement techniques and instrumentation. These practices vary significantly, leading to confusion and misunderstanding between researchers, development organizations, contract agencies and customers. The trend towards multi-company and multi-national engine projects increases these difficulties. The goal is to recommend practices, the application of which will generate confidence through a common understanding, which will increase the quality of the data obtained. The recommended practices described address components and instrumentation, and the problems of interpreting the information obtained in terms of spatial and temporal resolution. Measurement uncertainties are discussed in detail. Author

N90-29394*# TRW Defense and Space Systems Group, Redondo Beach, CA.
GENERALIZED ADVANCED PROPELLER ANALYSIS SYSTEM (GAPAS). VOLUME 2: COMPUTER PROGRAM USER MANUAL
L. Glatt, D. R. Crawford, J. B. Kosmatka, R. J. Swigart, and E. W. Wong Dec. 1986 484 p
(Contract NAS3-22251)
(NASA-CR-185277; NAS 1.26:185277) Avail: NTIS HC A21/MF A03 CSCL 01C

The Generalized Advanced Propeller Analysis System (GAPAS) computer code is described. GAPAS was developed to analyze advanced technology multi-bladed propellers which operate on aircraft with speeds up to Mach 0.8 and altitudes up to 40,000 feet. GAPAS includes technology for analyzing aerodynamic, structural, and acoustic performance of propellers. The computer code was developed for the CDC 7600 computer and is currently available for industrial use on the NASA Langley computer. A description of all the analytical models incorporated in GAPAS is included. Sample calculations are also described as well as users requirements for modifying the analysis system. Computer system core requirements and running times are also discussed. Author

N90-29395# Arnold Engineering Development Center, Arnold Air Force Station, TN.
CALIBRATION OF THE PARC PROGRAM FOR PROPULSION-TYPE FLOWS Final Report, 1 Oct. 1988 - 1 Jun. 1990
G. D. Garrard and W. J. Phares (Sverdrup Technology, Inc., Arnold AFS, TN.) Jul. 1990 107 p Submitted for publication
(AD-A224253; AEDC-TR-90-7) Avail: NTIS HC A06/MF A01 CSCL 21/5

The purpose of this Technical Report is to provide documentation of recent efforts towards the calibration of the PARC program for various types of flows experienced in the testing of turbine engines and rocket motors. This report provides a systematic and comprehensive assessment of the PARC program's capabilities and provides a baseline capability against which future modifications to the PARC program can be assessed. The work documented herein is based on a building block calibration approach and is a continuation of efforts started in FY-87. The present work revisits some of the earlier cases and expands into other, more complex flow problems with features similar to those found in the ETF test environments. The discussion of each calibration case is broken down into three parts. The motivation for selecting a particular flow problem for the PARC calibration is discussed first. That section will identify how each calibration case is related to typical testing problems within ETF and why it is important that it be included in this report. The actual test cases used for each calibration case are discussed. Particular emphasis is placed on where the data were obtained. The CFD results obtained in the study are documented and discussed in the third section, along with a description of grids, boundary conditions, and initial conditions used in the study. GRA

N90-29396# Dayton Univ., OH. Aerospace Mechanics Div.
STRUCTURAL TESTING AND ANALYTICAL RESEARCH OF TURBINE COMPONENTS Final Report, Sep. 1985 - Jun. 1989
M. Swaminadham 2 Oct. 1989 307 p
(Contract F33615-85-C-2585; AF Proj. 3066)
(AD-A223516; UDR-TR-89-60; WRDC-TR-89-2126) Avail: NTIS HC A14/MF A02 CSCL 21/5

Finite-element based deterministic and probabilistic analytical methods were applied for the normal mode and forced response characterization of simple-to-complex turbine and compressor components. Noncontacting blade deflection instrumentation - - four fiber optic plane-of-light sensors and dual Z-Grid wire systems were designed, built and tested for measuring blade tip deflections of rotating disks. Differential double pulse interferometry was applied for the mode shape definition of rotating bladed disks, and the full-field modal fringe patterns were quantitatively interpreted by the sine extrapolation technique. A joint effort for concurrent evaluation of the UTRC and UDRI non-interference blade measurement systems for measuring integral order vibration of a flexible disk was completed. Critical speeds and maximum blade tip deflections of a test disk from the two instrumentation systems were compared, and good agreement for the two test series results was seen. Results from the integrated NSMS (Noncontact Stress Measurement System) tests were also compared. The NSMS analysis software programs analyzed the optical probe array data and extracted blade-to-blade deflections and compared them with the interferometric data. GRA

N90-29397# National Aerospace Lab., Tokyo (Japan).
A COMPARISON OF SCRAMJET ENGINE PERFORMANCES OF VARIOUS CYCLES
Takeshi Kanda, Goro Masuya, Yoshio Wakamatsu, Nobuo Chinzei, and Akio Kanmuri Nov. 1989 17 p In JAPANESE; ENGLISH summary
(NAL-TR-1042; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Assuming an airframe-integrated hydrogen fueled scramjet engine, the performances were compared for engines of various engine cycles: an expander cycle, a staged combustion cycle, a coolant bleed cycle, and a gas generator cycle. Each engine was regeneratively cooled by liquid hydrogen. Effects of flight Mach number, flight dynamic pressure, and fuel injection to air dynamic pressure ratio were examined as related to the power balance of the propellant feed line. It follows that the system pressure of the closed loop cycle increases and the specific impulse of the open loop cycle decreases with increasing flight Mach number, flight dynamic pressure, or fuel injection to air dynamic pressure ratio, i.e., with increasing fuel injector manifold pressure. Of the four cycles, the coolant bleed cycle shows well balanced engine performance, keeping the system pressure within a reasonable range. Author

N90-29398# National Aerospace Lab., Tokyo (Japan).
ANALYSIS OF SCRAMJET ENGINE CHARACTERISTICS
Takeshi Kanda, Goro Masuya, Yoshio Wakamatsu, Nobuo Chinzei, and Akio Kanmuri Nov. 1989 24 p In JAPANESE; ENGLISH summary
(NAL-TR-1041; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

In a previous report, scramjet engine characteristics of different propellant feed cycles were compared, and engine performances discussed. In this study, a hydrogen fueled airframe-integrated scramjet was examined, considered the cooling of the airframe as well as the engine, and the dependence of engine characteristics on such parameters as flight Mach number, flight dynamic pressure, engine wall temperature, and engine scale were analyzed. It was found that the coolant required for the airframe is about 20 percent of the total coolant. Simple equations were derived which correlate fuel flow rate, engine overall thrust and specific impulse with those parameters. As for the airframe cooling, a new cycle was proposed in which the airframe cooling system has its own coolant feed system and does not depend on the engine operating conditions. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N90-29399# National Aerospace Lab., Tokyo (Japan). Control Div.
SHORT PERIOD CONTROL USING ANGULAR ACCELERATION FEEDBACK: COMPENSATION FOR FIRST LAG SERVO [KAKU KASOKUDO FI-DOBAKKU NIYORU KOUKU-KI NOTANSHU-KI SEIGYO: ICHIJI OKURE SA-BO NO HOSHO]
Masaaki Yanagihara, Masahiko Nagayasu, and Shuichi Sasa Feb. 1989 16 p In JAPANESE
(NAL-TM-600; ISSN-0452-2982; JTN-90-80188) Avail: NTIS HC A03/MF A01

In order to insure the dynamic pitching stability of an aircraft, the Stability Augmentation System (SAS) with angular velocity feedback was used for the short period control. The pitching motion due to gust, etc., can be stabilized automatically by this system. When the time constant of a first lag in servo system which drives an elevator is large, however, the damping of SAS sometimes becomes less effective as the feed back gain increases. The recovery method for the damping effect of SAS in which the angular acceleration of an aircraft was measured with angular accelerometer and used for the additional feedback for SAS was investigated. As the result, the lag of servo system was found to be compensated by the feedback of the angular acceleration and this technique was shown to be effective for the control of the gust response. NASDA

N90-29400 Stanford Univ., CA.
SAMPLE RATE EFFECTS ON DISTURBANCE REJECTION FOR DIGITAL CONTROL SYSTEMS Ph.D. Thesis
Hidetoshi Hirata 1990 212 p
Avail: Univ. Microfilms Order No. DA9017852

Sample rate effects on disturbance rejection are explored and general guidelines for a systematic sample rate selection are suggested. Many factors affecting the variation of the disturbance rejection, such as sensitivity to off-nominal plant parameters, effects of finite word length and analog prefilters as well as plant and controller design parameters are discussed. Two types of compensators are examined: (1) an optimal discrete synthesis based on a continuous quadratic cost function; (2) a simpler first-order lead compensator. The principal example used is a mass-spring-mass system. It is shown that sample rates have a significant effect on the performance of a discrete controller's disturbance rejection. Based on the representative examples analyzed, the performance of the systems where process disturbance is dominant, approaches the performance of a continuous controller to within 10 percent when using a sample rate of 40 or more times the closed-loop bandwidth, provided that there are no significant dynamics faster that the bandwidth. If a 50 percent degradation of the discrete system performance is acceptable, this can usually be achieved with a sample rate which is 8 times the closed-loop bandwidth. For systems where controllers add significant amounts of damping to lightly damped modes which are faster than the bandwidth, the open-loop frequencies of those modes have a large impact on the sample rate selection. Such lightly damped modes cause sensitive sample rates near integer fractions of twice the mode frequency, where the performance degrades significantly. In these cases, it may be necessary to increase the sample rate over that suggested above in order to maintain acceptable performance. Dissert. Abstr.

N90-29401# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. fuer Flugversuchstechnik.
PROCEDURE FOR CALIBRATING FLY-BY-WIRE CONTROL CHAINS OF THE FLYING TESTBED ATTAS
Adolf Zach and Wilhelm Reese 1990 37 p In GERMAN; ENGLISH summary
(DLR-Mitt-90-02; ISSN-0176-7739; ETN-90-97537) Avail: NTIS HC A03/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Rep. of Germany, HC 16 deutsche marks

The computer system of the flying testbed ATTAS (Advanced Technologies Testing Aircraft System) is used to control the most important systems by electrohydraulic actuators (fly-by-wire). For static calibration, the signals of the fly-by-wire control chains were measured in tests on ground. Some transfer functions were investigated, such as rudder position-actuator position, rudder position-actuator position controlling, rudder-position control path and actuator position controlling-control path. The results were analyzed by the interactive data processing software package DIVA, conceived for the evaluation of very large test data systems. ESA

N90-29402# National Aerospace Lab., Tokyo (Japan).
A DIGITAL CONTROLLER FOR ACTIVE AEROELASTIC CONTROLS
T. Ueda and K. Murota Feb. 1989 40 p In JAPANESE; ENGLISH summary
(NAL-TR-1014; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A high-speed digital controller for aeroelastic controls was designed and made. The purpose was to minimize adverse phase lag which is inevitably produced by the CPU time of digital processing. The delay deteriorates control performances on rather rapid phenomena like aircraft flutter. With fix-point operation the controller realized 417 microseconds of throughput time including the A/D and D/A conversion. This corresponds to a high sampling rate of 2.4 kHz. The controller furnishes two channels, each of which can be implemented with up to the eighth order control laws allowing the coupling terms. Control laws can be loaded by changing coefficients for multiplication in its expansion form. These coefficients are calculated and transferred by a peripheral computer through the GP-IB busline. At the stage of D/A conversion, the number of bit-shifts associated with a scaling is made programmable to avoid overflow and to lessen inaccuracy due to the truncation error. A sample period is also selectable through the GP-IB busline. This period ranges from 1 ms to 500 microsec. In the appendix, a program is presented for converting from the continuous transfer function in the Laplace domain to a discrete transfer function in the z-domain with the aid of Tustin's approximation. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N90-29403 Loughborough Univ. of Technology (England). Dept. of Transport Technology.
THE POTENTIAL FOR AN EXTRA RUNWAY AT HEATHROW: A PRELIMINARY FEASIBILITY STUDY
Angelos Beliyiannis, Kevin Byrne, Joseph Gavriilidis, Christopher Higgins, Alex Hoffmann, Mario Macedo, Amos Marawa, Mahmoud Mehalli, Ricardo RodriguesPacheco, and Mohamed Saeed et al Apr. 1990 66 p
(TT-9007; ISBN-0-904947-21-1) Copyright Avail: Issuing Activity

A preliminary examination of the feasibility of providing an off-airport auxiliary runway at Heathrow is presented. The runway will include facilities that are fully integrated with the main Heathrow terminals. In addition, an assessment of the operational and environmental consequences is discussed. The operational criteria of fleet mix, air traffic, runway length and location, air transport capacity, terminal transfer, and ground access are addressed. The airside, terminal, and apron designs are also covered. Noise

contours for varying runway lengths are provided as part of the noise impact assessment for Heathrow's planned auxiliary runway. Author

N90-29404# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
WORKSHOP ON LOW LEVEL FLIGHT TRAINING
1990 79 p Workshop Held in Ottobrunn, Fed. Republic of Germany, 23-27 Oct. 1989
(AGARD-AR-288; ISBN-92-835-0572-7) Copyright Avail: NTIS HC A05/MF A01; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The workshop investigates and reports on whether flight simulation technology might help resolve problems associated with low level flight training and suggests how AGARD might proceed in this area. Specifically the workshop: registers the existing requirements for low level flight training for mission events in which flight simulator technology shows the greatest potential for reducing the environmental impact of flight training while maintaining combat readiness; identifies ways that simulator technology can be applied to reduce the undesirable impact of low level flight training; investigates new training concepts that use alternative flight training in connection with simulators to meet flight training requirements; identifies ways to measure the effectiveness of simulator training in meeting operational training requirements; and suggests possible topics for follow-on technology studies or aerospace applications studies through which AGARD might contribute to a solution to the issue. Author

N90-29405# Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil).
A TANDEM SYSTEM OF IONIZATION CHAMBERS FOR EFFECTIVE ENERGY DETERMINATION OF UNKNOWN X-RADIATION FIELDS
Linda V. E. Caldas 1990 16 p
(DE90-630463; INIS-BR-2060; BR-9023202) Avail: NTIS (US Sales Only) HC A03/MF A01

Two parallel-plate ionization chambers with circular form, projected and manufactured at Instituto de Pesquisas Energeticas e Nucleares, Brazil, for low energy X-radiation, differ only in the collecting electrode and guard-ring materials: in one of them it is of graphite and in the other one, of aluminum. The great difference in their energy dependences allowed the formation of a Tandem system, that showed its ability in determining the effective energy (or HVL) and exposure rate of unknown X-radiation beams between 6 and 138 KeV, not requiring any absorbers or any special set-ups. DOE

N90-29406# Environmental Research Inst. of Michigan, Ann Arbor. Advanced Concepts Div.
ELECTRO-OPTICS ENGINEERING SUPPORT FOR THE INTEGRATED LAUNCH AND RECOVERY TELEVISION SURVEILLANCE SYSTEM Final Report, 1 Oct. 1989 - 30 Apr. 1990
Kenneth K. Ellis and Brad D. Neagle Jun. 1990 46 p
(Contract DLA900-88-D-0392)
(AD-A223450; ERIM-213400-54-F) Avail: NTIS HC A03/MF A01 CSCL 15/4

The Integrated Launch and Recovery Television Surveillance (ILARTS) System is used aboard U.S. aircraft carriers to provide aircraft landing information. The images are used to supplement the LSO's view during landing information. The images are used to supplement the LSO's view during landing operations. In addition, recorded imagery is used during pilot de-briefings and accident investigations. Operational requirements of the system are analyzed. The results of a vendor camera survey are summarized. Recommendations are made for modifying the system specification without loss of performance. The possibility of replacing visible light cameras with FLIRs (forward look infrared) is examined. Methods for quantifying and reducing blooming are discussed. GRA

N90-29407# Dayton Univ., OH. Research Inst.
TERRAIN VISUAL CUE ANALYSIS FOR SIMULATING LOW-LEVEL FLIGHT: A MULTIDIMENSIONAL SCALING APPROACH Interim Report, Jun. 1987 - Feb. 1990
James A. Kleiss Jun. 1990 27 p
(Contract F33615-87-C-0012)
(AD-A223564; AFHRL-TR-90-20) Avail: NTIS HC A03/MF A01 CSCL 08/2

Multidimensional scaling was used to analyze the features of real-world terrain that are salient to pilots during low-level flight. The stimuli were nine short (5-second duration) videotape segments depicting low-level, high-speed flight over a variety of terrain types. The segments were paired in all possible combinations, yielding a total of 36 stimulus pairs. Fifteen experienced pilots rate the visual similarity of each terrain pair on a 10-point scale anchored at 0 with Highly Dissimilar and at with Highly Similar. The rating data were submitted to a nonmetric multidimensional scaling analysis using the procedure ALSCAL. A 2-D solution yielded dimensions corresponding to: (1) terrain flatness/verticality, and (2) a composite of the size, density and spacing of scene elements. The only two A-10 pilots in the investigation weighted Dimension 2 much more heavily than did any other subjects. These results suggest that: (1) efforts should be directed toward effectively modeling vertical features such as hills and ridge lines in simulator visual scenes; (2) a high density of small scale and closely spaced scene elements (e.g., desert bushes) is less effective than larger scale, more distinguishable scene elements (e.g., buildings); and (3) mission requirements for certain aircraft (e.g., the V-10) may place special emphasis on particular types of scene content. GRA

N90-29408# Federal Aviation Administration, Washington, DC. Office of Airport Safety and Standards.
RELIABILITY AND PERFORMANCE OF FRICTION MEASURING TIRES AND FRICTION EQUIPMENT CORRELATION Final Report
Thomas H. Morrow Mar. 1990 377 p
(AD-A223694; DOT/FAA/AS-90/1) Avail: NTIS HC A17/MF A02 CSCL 01/3

This report contains the description and results of a test program conducted by the Federal Aviation Administration (FAA) at the National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF) located at Wallops Island, Virginia. The field tests were conducted in August 1989. The purpose of the test program was twofold: (1) to establish the reliability, performance and consistency of friction measuring tires used by qualified friction devices; and (2) select the best performing tire(s) for friction equipment correlation for maintenance purposes. Four friction devices were used with their self wetting systems on five types of pavement surfaces. Tests were conducted at speeds of 40 and 60 mph (65 and 95 km/h). A total of 1,643 test runs were conducted, which resulted in 2,725 data points, and 156 regression analyses were performed for the tire performance evaluation and 31 regression analyses for friction equipment correlation. The results showed that the McCreary tire performed best on the Saab Friction Tester (SFT), Runway Friction Tester (RFT) and Skiddometer (SKD). The Dico Tire performed the best on the Mu Meter (MUM). The tire composition given in ASTM E 524 for the McCreary tire will be included in a new ASTM specification that will have the same tire dimensions given in ASTM E 630. The DICO tire will be included in the ASTM E 670 specification. GRA

N90-29409 Physics and Electronics Lab. TNO, The Hague (Netherlands).
STUDY IMPROVEMENT TRAINING FACILITIES GROUND CONTROL AIR TRAFFIC CONTROLLERS. PART 2: FUNCTIONAL ANALYSIS APPROACH CONTROL TRAINER Final Report, Part 2, Sep. 1988-Sep. 1989
W. G. deJong and J. C. M. Mooijekind Oct. 1989 189 p In DUTCH; ENGLISH summary
(Contract A88/KLu/621)
(FEL-89-A280-Pt-2; TD-89-3865-Pt-2; ETN-90-97414) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, The Netherlands

A functional analysis was performed with a view to a feasibility study of alternatives for the improvement of the air traffic control training facilities. The approach air traffic control around the air bases of the Royal Netherlands Air Force is introduced. The functional specifications for an approach control trainer are presented. The functional analysis follows the Yourdon and DeMarco methodology which is introduced. The essential part of the functional analysis are the data flow diagrams, together with process and data specifications. ESA

N90-29410# National Aerospace Lab., Tokyo (Japan).
STUDIES OF SURFACE HEAT TRANSFER IN AN ARC-HEATED WIND TUNNEL
Takashi Matsuzaki, Ri-ichi Matsuzaki, Horoshi Miyaba, and Toshio Akimoto Dec. 1989 30 p In JAPANESE; ENGLISH summary
(NAL-TR-1048; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Feasibility studies of surface heat transfer were performed using an arc-heated wind tunnel. Three types of models were fabricated: a verification model (hemisphere cylinder with a diameter of 50 mm), a 1/100 scale nose model of the HOPE (H-2 Orbiting Plane), and a 1/100 scale wing-body model of the HOPE. They are made with a carbon fiber skin as thin as 1.5 mm, and a ceramic internal structure. Time histories of surface temperatures were measured by using an infrared thermograph system. Surface heat transfer rates were estimated from the measured surface temperatures and their time derivatives. The heat transfer distribution on the verification model showed reasonable agreement with existing theory. For both the nose model and the wing-body model, the surface heat transfer rates decreased monotonically along the lower centerlines, and increased with the angle of attack. For these models, thermographs of the surface heat transfer distribution are also shown. From these results, it is confirmed that the present method of estimating surface heat transfer rate is justified, and that the present experiment on surface heat transfer is not only applicable but also useful in an arc-heated wind tunnel. Author

N90-29411# National Aerospace Lab., Tokyo (Japan).
ESTIMATION OF POWER SPECTRAL DENSITY OF RUNWAY ROUGHNESS
Kosaburo Yamane and Tokuo Sotozaki Oct. 1989 33 p In JAPANESE; ENGLISH summary
(NAL-TR-1037; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Attention is focused on a power spectral density (PSD) method in order to evaluate runway roughness from the standpoint of airplane loads, and a procedure for estimating runway spectra is examined. It is shown that the low order trend (long wavelength component) included in a runway profile can seriously impair the estimated spectra, and therefore, a simple method to remove this trend is obtained. Next, power spectra of sixteen commercial runways are estimated, including the spectra of symmetric and anti-symmetric components between two tracks, to provide airplane design data on ground loads. Comparing the runway spectra obtained before and after overlay repair of runway surface, it is shown that the power spectral presentation is an effective method to evaluate runway roughness. Author

N90-29412# National Aerospace Lab., Tokyo (Japan).
THE FUNCTION OF THE INTERACTIVE MODEL ASSEMBLY PROGRAM (IMAP) FOR A FLIGHT SIMULATOR
Kaoru Wakairo, Akira Watanabe, and Shuichi Sasa Jan. 1989 80 p In JAPANESE; ENGLISH summary
(NAL-TR-1034; ISSN-0389-4010) Avail: NTIS HC A05/MF A01

The National Aerospace Laboratory (NAL) has a flight simulator for research and development of aircraft. The flight simulator is composed of a cockpit system, a visual system, a motion system, and a computer system for real-time calculation. A visual system is indispensable for piloted aircraft simulation. In 1966, NAL installed a visual system with a miniature model board. It generated imagery by using a servo-drive TV method. However, several years later it was requested to improve the movement speed and the range. In 1983, NAL upgraded the visual system to a CGI (Computer Generated Imagery) type system for the research and development of a new STOL (Short Take-Off and Landing) research aircraft. A CGI type visual system needs a large visual digital data base for a wide range scene. NAL developed the Interactive Model Assembly Program (IMAP). It is easy to make a visual data base with this program. The characteristics of the IMAP are as follows: interactive generation of visual data base; ease of editing a visual data base; fast searching of visual data base; real-time display of visual data base; and line drawing of a visual scene by using a graphic display. Up to the present the IMAP has been used for various simulation tests, such as the NAL STOL aircraft simulation, spacecraft rendezvous simulation, and re-entry simulation of a space plane. It has been proven that the program contributes to decreasing the time needed to make visual data. The IMAP functions and its hardware configuration in use are described. Lastly results are compared between the IMAP and the BMAP (Batch-type Model Assembly Program). Author

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N90-29413*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT MISSIONS. VOLUME 5A: DESCRIPTIONS OF ASTRONOMY, ASTROPHYSICS, AND SOLAR PHYSICS SPACECRAFT AND INVESTIGATIONS. VOLUME 5B: DESCRIPTIONS OF DATA SETS FROM ASTRONOMY, ASTROPHYSICS, AND SOLAR PHYSICS SPACECRAFT AND INVESTIGATIONS
Sang J. Kim, ed. Jun. 1988 127 p
(NASA-TM-101908; NSSDC/WDC-A-R/S-88-12-Vol-5A/B; NAS 1.15:101908) Avail: NTIS HC A07/MF A01 CSCL 22A

The main purpose of the data catalog series is to provide descriptive references to data generated by space science flight missions. The data sets described include all of the actual holdings of the Space Science Data Center (NSSDC), all data sets for which direct contact information is available, and some data collections held and serviced by foreign investigators, NASA and other U.S. government agencies. This volume contains narrative descriptions of data sets of astronomy, astrophysics, solar physics spacecraft and investigations. The following spacecraft series are included: Mariner, Pioneer, Pioneer Venus, Venera, Viking, Voyager, and Helios. Separate indexes to the planetary and interplanetary missions are also provided. M.G.

N90-29414*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT FLIGHT MISSIONS. VOLUME 2B: DESCRIPTIONS OF DATA SETS FROM GEOSTATIONARY AND HIGH-ALTITUDE SCIENTIFIC SPACECRAFT AND INVESTIGATIONS
Norman J. Schofield, ed., R. Parthasarathy, ed., and H. Kent Hills, ed. May 1988 151 p
(NASA-TM-101909; NSSDC/WDC-A-R/S-88-11-Vol-2B; NAS 1.15:101909) Avail: NTIS HC A08/MF A01 CSCL 22A

The main purpose of the data catalog series is to provide descriptive references to data generated by space science flight missions. The data sets described include all of the actual holdings of the Space Science Data Center (NSSDC), all data sets for which direct contact information is available, and some data collections held and serviced by foreign investigators, NASA and other U.S. government agencies. This volume contains narrative descriptions of data sets from geostationary and high altitude scientific spacecraft and investigations. The following spacecraft series are included: Mariner, Pioneer, Pioneer Venus, Venera, Viking, Voyager, and Helios. Separate indexes to the planetary and interplanetary missions are also provided. M.G.

N90-29415*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT MISSIONS. VOLUME 1A: DESCRIPTIONS OF PLANETARY AND HELIOCENTRIC SPACECRAFT AND INVESTIGATIONS, SECOND EDITION
Winifred Sawtell Cameron, ed. and Robert W. Vostreys, ed. Mar. 1988 125 p
(NASA-TM-101910; NSSDC/WDC-A-R/S-88-07-Vol-1A; NAS 1.15:101910) Avail: NTIS HC A06/MF A01 CSCL 22A

The main purpose of the data catalog series is to provide descriptive references to data generated by space science flight missions. The data sets described include all of the actual holdings of the Space Science Data Center (NSSDC), all data sets for which direct contact information is available, and some data collections held and serviced by foreign investigators, NASA and other U.S. government agencies. This volume contains narrative descriptions of planetary and heliocentric spacecraft and associated experiments. The following spacecraft series are included: Mariner, Pioneer, Pioneer Venus, Venera, Viking, Voyager, and Helios. Separate indexes to the planetary and interplanetary missions are also included. M.G.

N90-29416*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT MISSIONS. VOLUME 6: MASTER INDEX VOLUME
Richard Horowitz, Patricia A. Ross, and Joseph H. King Oct. 1989 151 p
(NASA-TM-101913; NSSDC/WDC-A-R/S-89-25-Vol-6; NAS 1.15:101913) Avail: NTIS HC A08/MF A01 CSCL 22A

The main purpose of the data catalog series is to provide descriptive references to data generated by space science flight missions. The data sets described include all of the actual holdings of the Space Science Data Center (NSSDC), all data sets for which direct contact information is available, and some data collections held and serviced by foreign investigators, NASA, and other U.S. government agencies. This volume contains the Master Index. The following spacecraft are included: Mariner, Pioneer, Pioneer Venus, Venera, Viking, Voyager, and Helios. Separate indexes to the planetary and interplanetary missions are also provided. M.G.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N90-29417# Naval Ocean Systems Center, San Diego, CA. Electro-Optic Systems.
SATELLITE CONSTELLATION ORBIT EVALUATION (SCORE) PROGRAM Final Report
L. C. Russell Apr. 1990 67 p
(AD-A223531; NOSC/TR-1345) Avail: NTIS HC A04/MF A01 CSCL 12/5

The objective of this research was to produce a flexible, user-friendly, PC-based computer program that could assist in evaluating satellite constellations. The program would need the capability to graphically display various facets of satellite orbits and communication coverages. Both low earth-orbit and high earth-orbit satellites, would need to be evaluated. The Satellite Constellation Orbit Evaluation Program (SCORE) can be used to graphically display satellite orbits and communication coverages. Although originally developed for the Navy/Defense Advanced Research Projects Agency Satellite Laser Communications (SLC) Program, SCORE can be used to assist in the evaluation of any satellite-communication or surveillance system. A DOS floppy disk containing the executable code for SCORE is included with this report. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N90-29418# Ballistic Research Labs., Aberdeen Proving Ground, MD.
APPLICATION OF A RECHARGEABLE, SMALL CALIBER RAILGUN POWER SUPPLY Final Technical Report, Jan. - Dec. 1989
Alexander E. Zielinski and Keith A. Jamison Jul. 1990 36 p Sponsored by Army Close Combat Armament Center, Picatinny Arsenal, NJ
(AD-A224207; BRL-TR-3118) Avail: NTIS HC A03/MF A01 CSCL 20/3

A capacitive power supply for driving a railgun load was developed using solid-state switch gear and electrolytic capacitors. Electrolytic capacitors and solid state switching devices allow relative ease of component orientation and insensitivity to field conditions. The circuit is constructed such that half the bank capacitance is initially charged while the other half is uncharged. Both halves are connected in series with the load. When the discharge is initiated, the current passing through a railgun simultaneously charges the uncharged section of the capacitor bank. The current waveform is nearly sinusoidal; its half-cycle time may be easily matched to the projectile acceleration time by including a series inductor. Theoretical results and experimental data are presented from a 4 module, 7500 J and 30 kA per module, laboratory setup. This type of supply is ideal for use with augmented and multiturn railguns. In these configurations, the pulse shaping inductance becomes part of the railgun itself. Because the circuit may be timed so that zero current coincides with projectile exit, projectile tip off is reduced and firing becomes flashless. In fact, since the SCRs open when the load current goes to zero, the current zero may precede projectile exit. GRA

N90-29419# European Space Agency, Paris (France).
AN INTRODUCTORY GUIDE PREPARING TO USE THE ESTEC ENVIRONMENTAL TEST FACILITIES
Valerie David, ed. Apr. 1990 39 p Original contains color illustrations
(ESA-TM-05; ISSN-1013-7076; ETN-90-97592) Copyright Avail: NTIS HC A03/MF A01

The aim of this brochure is to provide potential users of the ESTEC test facilities with a series of indications which will enable them to plan their test runs in the most efficient manner. It provides a brief overview of the ESTEC test center organization and facilities, and outlines the responsibilities and obligations of both the customer and the test center including a very brief outline of the financial aspects. ESA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

No abstracts in this category.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

No abstracts in this category.

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N90-29420# National Aerospace Lab., Tokyo (Japan).
THEORETICAL SPECIFICATIONS OF THE TRAJECTORY ESTIMATION FOR A SPACE NAVIGATION SYSTEM WITH THE FUNCTION OF GUIDANCE AND CONTROL
Toru Shiho Aug. 1989 40 p In JAPANESE; ENGLISH summary
(NAL-TR-1032; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The theoretical specifications of the trajectory estimation for a space navigation system (observation and trajectory estimation processes with the function of guidance and control) of STANPS-N are presented. STANPS-N is the acronym for Space Trajectory and Mission Analysis Program System (Navigation version) developed at National Aerospace Laboratory. Observation data from the range and range-rate radar are processed sequentially by the conventional Kalman filter or extended Kalman filter with the system noise compensation method. Unknown parameters (for example, observation bias, station location, astronomical and geophysical constants) can also be estimated by the enlarged system formulation. The evaluation algorithms for the effect of the impulsive velocity correction on the change of estimate and error covariance matrix are also presented. Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N90-29421# National Space Development Agency, Tokyo (Japan).
A THREE AXIS ATTITUDE CONTROL OF A SATELLITE
Sosuke Goto and Shin-ichiro Ichikawa Dec. 1988 220 p In JAPANESE; ENGLISH summary
(NASDA-TR-22; JTN-90-80152) Avail: NTIS HC A10/MF A02

A concept is described of a three axis attitude control of a satellite for operators of satellite tracking and for beginners of a satellite attitude control design. For an easier understanding of the basic concept of the attitude control of BS-2b (Broadcasting Satellite-2b) and other satellites, the answers to the following questions are examined: (1) What are the characteristics of a three axis attitude controlled satellite on a synchronized orbit; (2) What is the purpose of a satellite attitude control; (3) What kinds of disturbance exist on satellite orbits; (4) How do they affect satellites; (5) Why is wheel-control important; (6) What kinds of satellite rotation sensors exist, and what are their limitations; (7) What is the difference between zero-momentum method and bias-momentun method; (8) What are actuators that control various disturbances, and what are their characteristics; (9) What is a concept of automatic control as a guide for understanding satellite attitude control system; and (10) What is a conceptual drawing of an altitude control system. The above-mentioned items are not enough, because the operations of the attitude control systems of various types of satellites are individually different and complicated. Therefore, the attitude control systems of BS-2b, MOS-1 (Marine Observation Satellite-1) and ETS-5 (Engineering Test Satellite-5) are shown as examples. NASDA

N90-29422# National Aerospace Lab., Tokyo (Japan). Space Station Working Group.
UTILIZATION OF SPACE STATION, PART 3 [UCHU SUTE-SHON NO RIYOU NITSUITE (SONO SAN)]
Yasutoshi Inoue, Yasuo Watanabe, Seishirou Kibe, Kotaro Matsumoto, Masao Naka, Hiromichi Yamamoto, Keiji Nitta, Toshiharu Tanemura, Yoshinori Fujimori, and Koji Ohtsubo et al Oct. 1988 86 p In JAPANESE
(NAL-TM-597-Pt-3; ISSN-0452-2982; JTN-90-80187) Avail: NTIS HC A05/MF A01

Research on the utilization of the space environment has been performed since 1985. This research is very important because the international space station becomes available in 1994. In the space development committee, the policy of space development in Japan is under discussion and the development of space structure in orbit and aerospace planes is likely to be planned. This research is thought to become more important under such circumstances. The members of the working group on the space station in National Aerospace Laboratory Japan discussed the utilization of the space environment in 1987. Topics offered in the discussion are examined. Included items are: (1) Deployable Truss Beam; (2) Regeneration and Circulation System for Water and Gas; (3) Utilization of Catalyst for the Treatment of Excrement; (4) Payload-Tether System; (5) Boomerang Payload; (6) Expert System for Space Experiment; (7) Solar Rocket; (8) Collector Type Solar Power System; and (9) Mirror Segment for Solar Collector. NASDA

N90-29423*# Boeing Aerospace Co., Seattle, WA. Engineering Technology Organization.
NONLINEAR MODELING OF JOINT DOMINATED STRUCTURES Final Report
J. M. Chapman Washington NASA Sep. 1990 213 p (Contract NAS1-18864)
(NASA-CR-4324; NAS 1.26:4324) Avail: NTIS HC A10/MF A02 CSCL 22B

The development and verification of an accurate structural model of the nonlinear joint-dominated NASA Langley Mini-Mast truss are described. The approach is to characterize the structural behavior of the Mini-Mast joints and struts using a test configuration that can directly measure the struts' overall stiffness and damping properties, incorporate this data into the structural model using the residual force technique, and then compare the predicted response with empirical data taken by NASA/LaRC during the modal survey tests of the Mini-Mast. A new testing technique, referred to as 'link' testing, was developed and used to test prototype struts of the Mini-Masts. Appreciable nonlinearities including the free-play and hysteresis were demonstrated. Since static and dynamic tests performed on the Mini-Mast also exhibited behavior consistent with joints having free-play and hysteresis, nonlinear models of the Mini-Mast were constructed and analyzed. The Residual Force Technique was used to analyze the nonlinear model of the Mini-Mast having joint free-play and hysteresis. Author

N90-29424*# Dynamic Engineering, Inc., Newport News, VA.
SUSPENSION SYSTEMS FOR GROUND TESTING LARGE SPACE STRUCTURES Final Report
Ronald R. Gold, Inger P. Friedman, Wilmer H. Reed, III, and W. L. Hallauer (Virginia Polytechnic Inst. and State Univ.,

Blacksburg.) Washington NASA Oct. 1990 112 p (Contract NAS1-18798)
(NASA-CR-4325; NAS 1.26:4325; D-377) Avail: NTIS HC A06/MF A01 CSCL 22B

A research program is documented for the development of improved suspension techniques for ground vibration testing of large, flexible space structures. The suspension system must support the weight of the structure and simultaneously allow simulation of the unconstrained rigid-body movement as in the space environment. Exploratory analytical and experimental studies were conducted for suspension systems designed to provide minimum vertical, horizontal, and rotational degrees of freedom. The effects of active feedback control added to the passive system were also investigated. An experimental suspension apparatus was designed, fabricated, and tested. This test apparatus included a zero spring rate mechanism (ZSRM) designed to support a range of weights from 50 to 300 lbs and provide vertical suspension mode frequencies less than 0.1 Hz. The lateral suspension consisted of a pendulum suspended from a moving cart (linear bearing) which served to increase the effective length of the pendulum. The torsion suspension concept involved dual pendulum cables attached from above to a pivoting support (bicycle wheel). A simple test structure having variable weight and stiffness characteristics was used to simulate the vibration characteristics of a large space structure. The suspension hardware for the individual degrees of freedom was analyzed and tested separately and then combined to achieve a 3 degree of freedom suspension system. Results from the exploratory studies should provide useful guidelines for the development of future suspension systems for ground vibration testing of large space structures. Author

N90-29425*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
A NEW MOMENTUM MANAGEMENT CONTROLLER FOR THE SPACE STATION
B. Wie, K. W. Byun, and V. W. Warren Jan. 1988 34 p Previously announced in IAA as A88-50233
(Contract NCC9-16)
(NASA-CR-187265; NAS 1.26:187265) Avail: NTIS HC A03/MF A01 CSCL 22B

A new approach to CMG (control moment gyro) momentum management and attitude control of the Space Station is developed. The control algorithm utilizes both the gravity-gradient and gyroscopic torques to seek torque equilibrium attitude in the presence of secular and cyclic disturbances. Depending upon mission requirements, either pitch attitude or pitch-axis CMG momentum can be held constant: yaw attitude and roll-axis CMG momentum can be held constant, while roll attitude and yaw-axis CMG momentum cannot be held constant. As a result, the overall attitude and CMG momentum oscillations caused by cyclic aero-dynamic disturbances are minimized. A state feedback controller with minimal computer storage requirement for gain scheduling is also developed. The overall closed-loop system is stable for + or - 30 percent inertia matrix variations and has more than + or - 10 dB and 45 deg stability margins in each loop. Author

N90-29426# Sandia National Labs., Albuquerque, NM. Aerospace Projects Div.
USER'S MANUAL FOR THE TRAJECTORY SIMULATION AND ANALYSIS PROGRAM (TSAP)
David E. Outka 31 Jul. 1990 149 p Revised
(Contract DE-AC04-76DP-00789)
(DE90-014850; SAND-88-3158-Rev) Avail: NTIS HC A07/MF A01

The Trajectory Simulation and Analysis Program (TSAP) provides a generalized package for studying point-mass trajectory problems. TSAP expands upon the input and output features of the code PMAST, from which it is derived. All important features, such as trajectory segmentation, iterative parameter searches and surveys, user defined output values, and target vehicle simulation, have been maintained and often improved. Differences include the ways in which vehicle orientation can be defined, the free format table input option, the coordinate systems for initial condition specification, and the capability to simulate vehicle launch from zero velocity. This report documents the mathematical basis of the trajectory simulation and explicitly defines the input and output variables. General input gruidelines and examples are also presented. DOE

N90-29427# European Space Agency, Paris (France).
THE ULYSSES DATA BOOK: A SUMMARY OF THE TECHNICAL ELEMENTS OF THE ULYSSES SPACECRAFT AND ITS SCIENTIFIC PAYLOAD
H. Bachmann, P. Beech, K. D. Bock, P. Buia, P. J. Caseley, D. Eaton, A. Hawkyard, K. Leertouwer, R. G. Marsden, and K.-P. Wenzel et al Jun. 1990 52 p Original contains color illustrations
(ESA-BR-65; ISBN-92-9092-039-4; ISSN-0250-1589; ETN-90-97594) Copyright Avail: NTIS HC A04/MF A01; EPD, ESTEC, Noordwijk, The Netherlands, HC 20 Dutch guilders

The joint ESA-NASA venture, Ulysses, is described. The prime objective of the mission is to send a spacecraft to make measurements at high solar latitudes, and preferably over the poles of the Sun, the Earth's nearest star. The complete mission including the passes over both solar poles will take five years. Technical and scientific missions, the spacecraft and subsystems, and experiment payload are described. Experiments relate to solar wind plasma and ion composition, cosmic dust, magnetic field, solar x ray and cosmic ray burst, energetic particle and interstellar gas, low energy charged particle, cosmic ray and solar particle, unified radios and plasma wave, and radio science. ESA

N90-29428# European Space Agency, Paris (France).
ECS: SIXTH YEAR IN ORBIT
W. D. Baston, P. Button, B. Demelenne, K. R. Derbyshire, P. J. Leggett, H. Meier, W. E. Neumann, E. Tilmans, R. Viddeleer, and W. R. Burke, ed. May 1990 40 p Original contains color illustrations
(ESA-BR-70; ISBN-92-9092-059-9; ISSN-0250-1589; ETN-90-97596) Copyright Avail: NTIS HC A03/MF A01

The experience gained with the European Communications System (ECS) satellites during the sixth year of service in orbit from July 1988 to June 1989 is summarized. Appraisals of how various satellite systems performed are given and significant events are identified. A very significant event was the addition of a fourth orbiting satellite, ECS-5. A star camera on board used as a technology experiment is described. The spacecraft's general early history is detailed. In fact, ECS-5 was originally destined to replace ECS-1; owing to a channel failure, however, a more complex reshuffling of the spacecraft orbital positions was decided upon. A less significant event in the ECS system history, was the passing of the 1 million operating channel hour milestone. The exact figure (at the end of the reporting period) is 1,019,901 operating channel hours, the equivalent of 116.3 channel years. In the reporting period, the total unplanned traffic interruption was only 2170 seconds during a total of 270,749 channel operating hours, representating a payload availability of 0.999998. ESA

N90-29429# Royal Aerospace Establishment, Farnborough (England).
SATELLITE MOTION IN AN AXI-SYMMETRIC GRAVITATIONAL FIELD. PART 1: PERTURBATIONS DUE TO J2 (SECOND ORDER) AND J3
R. H. Gooding 17 Nov. 1988 131 p
(RAE-TR-88068; RAE-Space-673; BR113779; ETN-90-97602) Copyright Avail: NTIS HC A07/MF A01

Full details of the untruncated second order orbital theory are given. The analysis only takes account of the first two zonal harmonics, (geopotential assumed). The principal merit of the theory derives from the extreme compactness of the results obtained for short period perturbations in position and velocity, these perturbations being expressed relative to a system of spherical polar coordinates based on a rotating 'mean orbital plane'. The use of osculating elements is thereby avoided, and mean elements are defined so as to give the coordinate pertubations

their simplest possible form. To make the theory both complete and compact, an intermediate set of elements, described as 'semi-mean', is also required. ESA

N90-29896*# Tokyo Inst. of Tech. (Japan). Dept. of Mechanical Engineering Science.
EXPERIMENTAL STUDY ON TWO-DIMENSIONAL FREE-FLYING ROBOT SATELLITE MODEL
Yoji Umetani and Kazuya Yoshida *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 215-224 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 22B

N90-29912*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AN INTELLIGENT, FREE-FLYING ROBOT
G. J. Reuter, C. W. Hess, D. E. Rhoades, L. W. McFadin, K. J. Healey, J. D. Erickson, and Dale E. Phinney (Lockheed Engineering and Sciences Co., Houston, TX.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 373-379 Previously announced in IAA as A90-10354 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N90-29430*# Alabama Univ., Huntsville. Dept. of Biological Sciences.
DEFINITION OF A NEAR REAL TIME MICROBIOLOGICAL MONITOR FOR SPACE VEHICLES Final Report
Melvin V. Kilgore, Jr., Robert J. Zahorchak, and William F. Arendale Sep. 1989 302 p Original contains color illustrations
(Contract NAS9-17973)
(NASA-CR-185599; NAS 1.26:185599; UAH-812) Avail: NTIS HC A14/MF A02; 3 functional color pages CSCL 22B

Efforts to identify the ideal candidate to serve as the biological monitor on the space station Freedom are discussed. The literature review, the evaluation scheme, descriptions of candidate monitors, experimental studies, test beds, and culture techniques are discussed. Particular attention is given to descriptions of five candidate monitors or monitoring techniques: laser light scattering, primary fluorescence, secondary fluorescence, the volatile product detector, and the surface acoustic wave detector. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N90-29431# Naval Weapons Center, China Lake, CA.
A PLANAR ROCKET MOTOR MODEL FOR VISUALIZATION OF VIOLENT REACTION DUE TO FRAGMENT IMPACT Research Report, Sep. 1989 - Jan. 1990
S. A. Finnegan, J. K. Pringle, J. C. Schulz, and M. D. Alexander May 1990 55 p
(AD-A224273; AD-E901001; NWC-TP-7074) Avail: NTIS HC A04/MF A01 CSCL 19/10

A planar model of a rocket motor with an inner bore has been developed to study reaction mechanisms associated with fragment impact. GRA

N90-29432# Air Force Office of Scientific Research, Bolling AFB, Washington, DC.
AFOSR/ONR CONTRACTORS' MEETING ON COMBUSTION ROCKET PROPULSION DIAGNOSTICS OF REACTING FLOW Technical Report, Jun. 1988 - Jun. 1989
J. M. Tishkoff, M. A. Birkan, G. S. Roy, and S. G. Lekoudis 19 Jun. 1989 371 p Meeting held in Ann Arbor, MI, 19-23 Jun. 1989 Sponsored by ONR, Arlington, VA and Michigan Univ., Ann Arbor
(AD-A224411; AFOSR-TR-90-0833) Avail: NTIS HC A16/MF A02

Abstracts are given for research on airbreathing combustion, rocket propulsion, and diagnostic of reacting flow supported by the AFOSR and the ONR. Author

N90-29433# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SOLID FUEL COMBUSTION CHAMBER Progress Report No. 16, Jun. - Dec. 1989
H. Wittenberg, P. A. O. G. Korting, B. T. C. Zandbergen, ed., T. Wijchers, P. J. M. Elands, J. P. deWilde, and F. Dijkstra Jun. 1990 23 p Prepared in cooperation with Prins Maurits Lab. TNO, Rijswijk, Netherlands
(LR-634; PML-1990-C50; SFCC-59; ETN-90-97645) Avail: NTIS HC A03/MF A01

An overview of the July to December 1989 period of the Solid Fuel Combustion Chamber (SFCC) project (phase 2) is given. This project was initiated in 1982 and aims at developing a capability to predict the performance of SFCC's in order to be able to evaluate the SFCC for e.g., Solid Fuel Ramjet (SFRJ) propulsion, hybrid rocket propulsion, turbine propulsion and for the clean combustion of waste materials. The planned work is directed at improving the knowledge of the combustion behavior (i.e., regression behavior, combustion efficiency, flame temperature and composition flammability limits and combustion instability) in turbulent channel flows (variables to be considered chamber pressure, mass flow, air temperature, and oxygen content of the air); determining the effects of size, configuration variables (inlet shape, aft mixing chamber/bypass) and different fuels (including waste materials) on the combustion behavior. To this end, both experimental and theoretical research activities are planned. Management, finances and personnel, activities, project status, utilization aspects, student involvement, and publications, reports, presentations and contacts are reviewed. ESA

N90-29434# National Aerospace Lab., Tokyo (Japan).
COMBUSTION CHARACTERISTICS OF OXYGEN/HYDROGEN HIGH PRESSURE PREBURNERS FOR STAGED COMBUSTION CYCLE ROCKET ENGINE
Fumiei Ono, Hiroshi Tamura, Hiroshi Sakamoto, and Masaki Sasaki Nov. 1989 32 p In JAPANESE; ENGLISH summary
(NAL-TR-1044; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The influence of preburner design and operating conditions on the combustion characteristics of high pressure fuel rich preburners with oxygen/hydrogen propellant was experimentally evaluated using small scale hardware. Seven different types of preburners whose injectors consisted of one to six coaxial type injection elements were tested. Gaseous oxygen at room temperature and liquid oxygen were used as oxidizers and gaseous hydrogen at room temperature and hydrogen at low temperatures were used as fuel. Testing also covered a combustion pressure range of 5.0 to 15.1 MPa, an oxidizer to fuel ratio range from 0.22 to 0.83 and an injection element propellant flow rate range from 0.026 to 0.238 kg/sec. Combustion performance and gas temperature uniformity data are presented for each preburner. Measured combustion performances were nearly 100 percent for all preburners over the tested range. Measured temperature uniformity was correlated by an empirical correlation parameter which accounts for the effects of oxidizer to fuel ratio, shear force due to oxygen and hydrogen injection velocity difference, and combustion gas residence time. Abnormal combustion phenomena which were characterized by abnormally low combustion performance and low combustion gas temperatures were observed.

The phenomena were interpreted to mean that the propellant injected from some coaxial elements did not burn due to misignition. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

N90-29435# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
ORGANIC POLYRADICAL MODELS FOR ORGANIC MAGNETIC MATERIALS Technical Report, period ending Oct. 1989
David A. Modarelli, Frank C. Rositto, Masaki Minato, and Paul M. Lahti 6 Mar. 1990 8 p Presented at the Materials Research Society Meeting, Boston, MA, Fall, 1989 Submitted for publication Exxon Education Foundation
(Contract N00014-87-K-0464; NSF CHE-87-12319)
(AD-A223691; TR-14) Avail: NTIS HC A02/MF A01 CSCL 07/6

A variety of model organic high spin molecules based upon coupled phenoxy and phenylnitrene systems was examined by semiempirical MO-CI theory. Experimental methodology using photochemical and thermal methods in solution and solid phases to generate and study phenoxy groups for investigation of model systems is presented. Solid phase (polymethyl methacrylate (PPMA) matrix) ESR spectra for the solution-transient m- and p-stilbeneoxyl radicals are presented. These radicals do not persist even in rigid matrix at temperature above 190 K, and appear to decompose in a site specific manner as the PPMA matrices are warmed to room temperature. The 2,6-Tert butylated phenoxyl radicals persist in PPMA for days under room conditions (solutions of these in air decompose within a day or two). The prospect of achieving partial orientation of phenoxyl radicals in polymer matrices is described. GRA

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N90-29436# National Aerospace Lab., Tokyo (Japan). Airflames Div.
SURFACE EFFECT FOR TEST PIECE ON FLEXURAL TEST OF CARBON FIBER REINFORCED PLASTIC LAMINATES [CFRP NO MAGE TOKUSEI NIOYOBOSU SHIRYO HYOUMEN JOTAINIKANSURU HYOUKA SHIKEN]
Yoshio Noguchi Feb. 1989 10 p In JAPANESE
(NAL-TM-601; ISSN-0452-2982; JTN-90-80189) Avail: NTIS HC A02/MF A01

It is very difficult to evaluate carbon fiber reinforced plastics (CFRP) because of the high strength, high elasticity, and high anisotropy. One of evaluation systems is a four-point bending test of CFRP, in which the effects of molding method on both the bending characteristics (where one-direction reinforced material is molded by autoclaves) and the film set up between the specimen and the loading point are investigated. Results are as follows: (1) The bending strength is influenced very much by differences between upper and lower surfaces of breed-molding plastics; (2) Data of bending elasticity are very similar to that estimated by the composition law; (3) Relations between the material and thickness and the components and surface conditions of specimen are captured very well when using the film between the loading point and the specimen; and (4) Bending strength is approx. = to the estimated data of the tension strength by a composite law, which considers the deflection in the case of the bending destruction shown at the center between loading points. NASDA

N90-29437 Ohio State Univ., Columbus.
VARIATIONAL FORMULATION AND FINITE ELEMENT IMPLEMENTATION OF PAGANO'S THEORY OF LAMINATED PLATES Ph.D. Thesis
Hui-Huang Abel Chyou 1989 228 p
Avail: Univ. Microfilms Order No. DA9011149

Pagano's theory of laminated plates is restated in the form of a set of self-ajoint differential equations. Identifying consistent boundary operators, a general variational principle is stated following standard procedures for coupled self-adjoint systems of equations. Extensions to relax requirements of differentiability of various field variables are indicated along with specializations to reduce the number of free field variables. In Pagano's theory of laminated plates, the stresses satisfy the equilibrium equations, strains are derived from stresses through the constitutive equations, and these are integrated to yield generalized displacement quantities. Continuity of displacements at the interfaces is enforced by expressing these in terms of the field variables and including the continuity equations in the set of equations to be solved. The number of mechanical variables is reduced from ten to eight by explicitly satisfying two of the equations of equilibrium. This reduces the number of equilibrium equations. There is a corresponding reduction in the number of generalized displacements and only eight constitutive equations. The new set of equations is shown to be self-adjoint in the inner product space. Based on this, consistent boundary operators are identified, and a general variational principle governing the problem is stated. Vanishing of the Gateaux differential of the governing functional is shown to correspond to the satisfaction of all the governing differential/algebraic field equations as well as the boundary conditions and internal continuity/discontinuity conditions. Extensions of the general variational principle are stated. One specialization in which the requirement of continuity of tractions and moments across internal surfaces is relaxed is used for development of a finite element computer program. The finite element procedure developed for the problem is verified against some exact solutions obtained by Pagano and used to determine the distribution of stresses in a twenty-two layer free-edge delamination coupon. Dissert. Abstr.

N90-29438# Boston Univ., MA. Center for Polymer Studies.
PERCOLATION AND LOW DENSITY MATERIALS: THEORY AND APPLICATIONS Final Report, 1 Oct. 1984 - 30 Sep. 1989
William Klein 30 Sep. 1989 46 p
(Contract DAAG29-84-K-0136)
(AD-A224237; ARO-21654.9-PH) Avail: NTIS HC A03/MF A01 CSCL 11/4

In the past several years it has become increasingly clear that connectivity or percolation concepts play an important role in understanding the properties of low density materials. The full exploitation of this important link between material properties and connectivity has, until recently, been hampered by the scarcity of reliable methods to handle the complex connectivity problem and the lack of tractable models that retain the essential physics. Substantial progress was made and with this progress the beginning of important applications of percolation to several materials problems such as elasticity, nucleation, spinodal decomposition and diffusion in disordered alloys. GRA

N90-29439# Johns Hopkins Univ., Baltimore, MD. Dept. of Mechanical Engineering.
THE OVERALL RESPONSE OF COMPOSITE MATERIALS UNDERGOING LARGE ELASTIC DEFORMATIONS Annual Technical Report, 1 Apr. 1989 - 31 Mar. 1990
Pedro Ponte Castaneda 13 Jun. 1990 66 p
(Grant AF-AFOSR-0288-89; AF Proj. 2302)
(AD-A224509; AFOSR-90-0765TR) Avail: NTIS HC A04/MF A01 CSCL 11/4

The main goal of this project is to estimate theoretically the overall or effective constitutive properties of nonlinear composite materials undergoing large deformations. Two types of large deformations are of interest; large elastic deformations, and large viscous deformations. The proposed method is to apply variational

principles that are under development to characterize the range of the effective properties given partial statistical information about the microstructure (such as the volume fractions of the phases). For some particular microstructures of interest exact estimates may be given. Significant progress was made over the first year with the development of a new variational principle allowing the estimation of the effective properties of a given nonlinear composite in terms of the effective properties of linear composites (which are assumed to be known). The potential significance of this work derives from its simplicity allowing the application of a large body of prior research on linear composites to nonlinear composites. The method has been applied to the case of large viscous deformations, and some results for particular materials systems have already been reported in the pertinent literature. GRA

N90-29440# California Univ., Santa Barbara.
HIGH PERFORMANCE BRITTLE MATRICES AND BRITTLE MATRIX COMPOSITES, BOOK 1 Final Report, 15 Mar. 1986 - 30 Sep. 1989
Anthony G. Evans and Robert Mehrabian 31 Dec. 1989 182 p
(Contract N00014-86-K-0178)
(AD-A223273) Avail: NTIS HC A09/MF A01 CSCL 11/4

The primary intent of this research was the development of composites having an acceptable combination of toughness and oxidation resistance. The study comprised three tasks. The first task was to study phase equilibria, solidification pathways and toughness properties of intermetallics, such as oxidation resistant Ti-Al-Ta and Nb-Al-Si alloys, and ceramics. These studies were then combined with interface interaction studies between the matrix microstructure and ductilizing/toughening particulates and fibers. The second task was a basic study of interface structure and chemistry as it relates to the mechanical properties of the interface. The third task involved studies on aluminum and copper matrix composites. These studies were concerned with developing an understanding of creep resistance. GRA

N90-29441# California Univ., Santa Barbara.
HIGH PERFORMANCE BRITTLE MATRICES AND BRITTLE MATRIX COMPOSITES, BOOK 2 Final Report, 15 Mar. 1986 - 30 Sep. 1989
Anthony G. Evans and Robert Mehrabian 31 Dec. 1989 285 p
(Contract N00014-86-K-0178)
(AD-A223274) Avail: NTIS HC A13/MF A02 CSCL 11/4

The primary intent of this research was the development of composites having an acceptable combination of toughness and oxidation resistance. The study comprised three tasks. The first task was to study phase equilibria, solidification pathways and toughness properties of intermetallics, such as oxidation resistance Ti-Al-Ta and Nb-Al-Si alloys, and ceramics. These studies were then combined with interface interaction studies between the matrix microstructure and ductilizing/toughening particulates and fibers. The second task was a basic study of interface structure and chemistry as it relates to the mechanical properties of the interface. The third task involved studies on aluminum and copper matrix composites. These studies were concerned with developing an understanding of creep resistance. GRA

N90-29442# Naval Air Development Center, Warminster, PA. Dept. of Air Vehicle and Crew Systems Technology.
A LOW COST SHADOW MOIRE DEVICE FOR THE NONDESTRUCTIVE EVALUATION OF IMPACT DAMAGE IN COMPOSITE LAMINATES Final Report, Oct. 1987 - Sep. 1988
Arthur E. Scotese 1 Mar. 1990 62 p
(AD-A223451; NADC-90011-60) Avail: NTIS HC A04/MF A01 CSCL 20/6

Studies conducted under this Independent Exploratory Development (IED) project have concentrated on developing a field inspection instrument for the detection of low-velocity impact damage and delaminations in laminated composites and honeycomb sandwich structures. A low cost, hand-held battery-powered damage detector was developed which can be operated under field conditions. This device can be used to detect minute surface perturbations resulting from foreign object impact that can cause disbond and/or delamination in aircraft structures. Since the operation of the device is simple and its detecting capability is not affected by temperature, humidity or vibration, it can be used under field operational conditions with minimum training. The entire detector system, including the power pack, weighs less than 3.5 lbs. GRA

N90-29443# Naval Air Development Center, Warminster, PA. Dept. of Air Vehicle and Crew Systems Technology.
EVALUATION OF ARALL-4: AN ARAMID FIBER REINFORCED ALUMINUM Final Report, 1 Oct. 1987 - 1 Oct. 1989
M. E. Donnellan, J. Cook, and C. Skowronek (Naval Research Lab., Washington, DC.) 5 Sep. 1989 32 p
(AD-A223502; NADC-89100-60031) Avail: NTIS HC A03/MF A01 CSCL 11/4

ARALL-4 was evaluated for the following: tensile properties at elevated temperatures; tensile properties in hot/wet conditions; moisture absorption; anisotropy and ballistic impact performance. The tensile properties of ARALL-4 exceed those of 2024-T8 in the longitudinal direction, but they are lower in the transverse direction. ARALL-4 retains excellent tensile properties after full saturation at 95 percent humidity and at 105 C. The moisture absorption of ARALL-4 is slow. The ballistic impact performance of ARALL-4 is inferior to several commonly used lightweight armor materials including: glass reinforced plastic, KEVLAR laminate, and titanium 6-4. GRA

N90-29444# North Carolina Univ., Chapel Hill. Dept. of Chemistry.
SIGMA AND pi INTERACTIONS OF THE PYRROLIC LIGAND SANDWICH-LIKE LANTHANIDE PHTHALOCYANINES DETERMINED FROM MAGNETIC SUSCEPTIBILITY AND LIGAND-FIELD THEORY Technical Paper
Juan Padilla and William E. Hatfield 25 Jun. 1990 22 p
Submitted for publication
(Contract N00014-89-J-1734)
(AD-A223609; TR-36) Avail: NTIS HC A03/MF A01 CSCL 20/3

Magnetic susceptibility data for praseodymium, neodymium, gadolinium, holmium, and erbium phthalocyanines taken in the temperature ranges 80 to 300 K or 4.2 to 300 K are reported. The sigma and pi-interactions of the pyrrolic nitrogen ligand with the praseodymium, neodymium, holmium, and erbium f-orbitals were obtained from angular overlap model ligand-field calculations including the full ground state manifold. The position of the pyrrolic nitrogen ligand in the metallic 2-D spectro-chemical series is reported. The results show that the pyrrolic nitrogen is a weak donor and a moderate donor ligand. The cross-term AOM parameter is necessary in order to get good fits. GRA

N90-29445# Pennsylvania State Univ., University Park. Composites Manufacturing Technology Center.
PREDICTION AND CONTROL OF PROCESSING-INDUCED RESIDUAL STRESSES IN COMPOSITES. PART 2: AS4/PEEK COMPOSITE Final Technical Report, Jun. 1987 - Jun. 1989
Kenneth J. Schulte and Hong T. Hahn Oct. 1989 89 p
(Grant AF-AFOSR-0242-87; AF Proj. 2302)
(AD-A223696; CMTC-8945-Pt-2; AFOSR-90-0570TR-Pt-2) Avail: NTIS HC A05/MF A01 CSCL 11/4

Residual stresses in symmetric cross-ply laminates were monitored by measuring the dimensionless curvature. The cooling rate was found to have a significant influence on the amount of residual stress in graphite/PEEK (APC-2) laminates. The transverse strain due to crystallization was not negligible and must be considered when predicting residual stresses for cooling rates of 75 deg C/min and lower. The stress-free temperature for O3/90(3) APC-2 laminates decreases with increasing cooling rate. Successive unconstrained heating/cooling provided the necessary environment for less stress relaxation allowing the specimens to move toward an equilibrium stress-free temperature (SFT) of 328 deg C. The SFT for any heating cycle was found to be equivalent to the previous cooling cycle SFT. The SFT is strongly dependent

on geometrical constraint during thermal cycling because of the stress relaxation. GRA

N90-29446# United Technologies Corp., East Hartford, CT.
DEVELOPMENT OF DUAL FIBER REINFORCED GLASS MATRIX COMPOSITES FOR STRUCTURAL SPACE BASED APPLICATIONS Final Report, 14 Mar. 1988 - 14 Mar. 1990
William K. Treadway and Karl M. Prewo 31 May 1990 50 p
(Contract N00014-88-C-0251)
(AD-A223801; UTRC-R90-917886-1) Avail: NTIS HC A03/MF A01 CSCL 11/2

The goal of the program was to create high specific stiffness, zero thermal composites for structural applications in space by using a dual fiber reinforcement approach. This approach consisted of adding large-diameter monofilaments as a secondary reinforcement to a pitch-based carbon fiber reinforced glass matrix composite. It was demonstrated that composite thermal expansion could be increased into the near-zero domain over the temperature range of interest (-100 C to +70 C) using a wide variety of monofilaments with and without fiber coatings. The use of uncoated boron monofilaments resulted in rather poor tensile performance and brittle fracture behavior due to degradation of the boron monofilaments during composite processing. The use of coated monofilaments resulted in a marked improvement in tensile strength and fracture behavior. GRA

N90-29447# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
POWDER PROCESSING OF ALUMINIDES M.S. Thesis
Osamu Kanou May 1990 61 p
(Contract DE-AC03-76SF-00098)
(DE90-015314; LBL-29214) Avail: NTIS HC A04/MF A01

This research was carried out to clarify the process variables in producing Nb3, Al/Nb composite material and to examine the usefulness of Nb phase as a reinforcement in this material. Two processes were investigated and it has been found that the synthesis and hot pressing method was suitable to produce highly densified Nb3, Al/Nb composite material. The hot pressed and heat treated specimen were examined by scanning electron microscopy, x ray spectroscopy, and x ray diffraction and micro indentation. It has been found that the specimen consisted of a Nb3, Al matrix and a Nb phase. Cracking was strongly influenced by the Nb phase: both crack formation and crack propagation were inhibited by the Nb phases. This effect was more evident in the specimen which contained more Nb phases. It has been concluded that the usefulness of dispersed Nb phase as a reinforcement in the brittle matrix has been proven. DOE

N90-29448# Oak Ridge National Lab., TN.
THE FRICTION AND WEAR OF LUBRICATED SI3N4/SIC(w) COMPOSITES
C. S. Yust and C. E. DeVore 1990 25 p Presented at the Joint STLE-ASME Tribology Conference, Toronto, Ontario, 7-10 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE90-015790; CONF-901071-7) Avail: NTIS HC A03/MF A01

The friction and wear of a 20 vol percent silicon carbide whisker-silicon nitride matrix composite was measured at room temperature in both lubricated and unlubricated sliding. A pin-on-desk test configuration was used in which the pin member was a 9.53-mm-dia sphere. Silicon carbide and silicon nitride spheres were tested against the composite in both unidirectional and reciprocating sliding. The range of experimental parameters included normal forces from 1 to 45 N, velocities of 0.1 and 0.3 m/s, and test durations of 5 min to 3 h. The lubricant used in the room temperature tests was a commercial synthetic, fully formulated engine oil (5W30). In unlubricated sliding, silicon nitride produced more severe wear of the composite than did silicon carbide. In lubricated sliding, very little wear occurs in either sliding pair at even the longest test exposure. The data are presented in wear space co-ordinates and this form of presentation is compared to other wear mechanism map concepts presently in use. DOE

N90-29449# California Univ., Berkeley. Lawrence Berkeley Lab. National Center for Electron Microscopy.
MICROSTRUCTURE OF ALPHA-Al BASE MATRIX/SiC PARTICULATE COMPOSITES
V. Radmilovic, G. Thomas, and S. K. Das (Allied-Signal Corp., Morristown, NJ.) Mar. 1990 20 p Sponsored in part by Research Fund of Serbia, Belgrade, Yugoslavia
(Contract DE-AC03-76SF-00098)
(DE90-014894; LBL-28366) Avail: NTIS HC A03/MF A01

The microstructures of monolithic Al--Fe--V--Si alloy and (alpha)-Al base matrix/SiC particulate composites (MMC) were characterized by conventional and high resolution transmission electron microscopy, microdiffraction and x ray spectroscopy techniques. Silicide particles of average composition Al12, (Fe,V)(4)Si are present in both of these materials. These particles are unstable under the electron beam at voltages above 200 kV, and exhibit radiation induced disordering. SiC particulates present in the MMC structure are predominantly of the hexagonal 6H polytype, but the hexagonal 5H polytype is also observed. A very thin reaction layer is present between the matrix and SiC particles. No segregation of alloying elements such as Fe, V, or Si at the m/SiC interface was observed. The second phase present at the (alpha)-Al/SiC interface seems to be a disordered silicide. DOE

N90-29450*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHARACTERIZATION OF UNNOTCHED SCS-6/Ti-15-3 METAL MATRIX COMPOSITES AT 650 C
W. D. Pollock (Analytical Services and Materials, Inc., Hampton, VA.) and W. Steven Johnson Sep. 1990 37 p Presented at the 10th ASTM Composite Materials Testing and Design Symposium, San Francisco, CA, 23-25 Apr. 1990 Submitted for publication
(NASA-TM-102699; NAS 1.15:102699) Avail: NTIS HC A03/MF A01 CSCL 11D

Ti-15-3 reinforced with SCS-6 silicon carbide fibers, in five different layups, was tested at 650 C to determine monotonic and fatigue strengths, basic mechanical properties, and damage initiation and progression. The elevated temperature results were compared to those obtained at room temperature. Analytical predictions were made of the monotonic stress-strain response as well as cyclic stress-strain hysteresis. The fiber reinforcement was found to significantly increase the static and fatigue strengths of the laminates over that of the matrix material at elevated temperature while the increase was insignificant at room temperature. Initial damage, in either the fibers or the matrix, was partitioned as a function of the life and applied strain range in the constituents. High strains and short lives resulted in multiple fiber failure with no signs of matrix fatigue cracking. Low strains and long lives resulted in extensive matrix cracking and no fiber breaks away from the fracture surface. At 650 C the matrix was too weak to cause fiber-matrix interface failure prior to matrix yielding. Laminate fatigue lives were hypothesized to be a function of the 0 deg fiber stress. More scatter was found in the 0 deg fiber stress vs. high temperature fatigue life data than for the room temperature data. An initial unloading modulus that was greater than the initial loading modulus was observed in the elevated temperature fatigue tests. Author

N90-29451# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
INTERLAMINAR SHEAR TESTS ON CONTINUOUS FIBER REINFORCED THERMOPLASTICS: THE EFFECTS OF RUBBER FORMING
L. G. Meyers Feb. 1990 23 p
(LR-621; ETN-90-97634) Avail: NTIS HC A03/MF A01

Interlaminar Shear Tests (ILS) were conducted on specimens made of Continuous Fiber Reinforced Thermo Plastic (CFRTP) laminates. The specimens were cut from a properly consolidated reference laminate and from two rubber formed profiles. The main goal was to examine the influence of a fast forming process (high cooling rates) on the mechanical properties of CFRTP laminates. From the results it appeared that the rubber forming process (under

the given conditions) does not affect the ILS values of an eight layer CFRTP laminate. Futhermore it can be concluded that the ILS test, although no valid failure modes will occur, can be used to examine the quality of the consolidation of a CFRTP laminate. ESA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N90-29452# Department of Energy, Washington, DC.
PULSED FIELD SAMPLE NEUTRALIZATION Patent Application
Anthony David Appelhans, inventor (to DOE), David Adrian Dahl, inventor (to DOE), and James Edward Delmore, inventor (to DOE) (Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.) Jul. 1989 27 p
(Contract DE-AC07-76ID-01570)
(DE90-015131; US-Patent-Appl-SN-375442; Patents-US-A7375442) Avail: NTIS HC A03/MF A01

An apparatus and method for alternating voltage and for varying the rate of extraction during the extraction of secondary particles, resulting in periods when either positive ions, or negative ions and electrons are extracted at varying rates. Using voltage with alternating charge during successive periods to extract particles from materials which accumulate charge opposite that being extracted causes accumulation of surface charge of opposite sign. Charge accumulation can then be adjusted to a ratio which maintains a balance of positive and negative charge emission, thus maintaining the charge neutrality of the sample. DOE

N90-29453# Brigham Young Univ., Provo, UT. Dept. of Chemistry.
NOVEL MACROCYCLIC CARRIERS FOR PROTON-COUPLED LIQUID MEMBRANE TRANSPORT Progress Report, 1 Dec. 1987 - 30 Nov. 1990
J. D. Lamb, J. S. Bradshaw, and R. M. Izatt Aug. 1990 6 p
(Contract DE-FG02-86ER-13463)
(DE90-015529; DOE/ER-13463/7) Avail: NTIS HC A02/MF A01

The research is divided into two principal parts: synthesis of macrocyclic compounds, and liquid membrane experiments. Manuscripts describing this work are listed in Part 3. DOE

N90-29454# Chemical Research and Development Center, Aberdeen Proving Ground, MD. Research Directorate.
ESTIMATION OF LIQUID HEAT CAPACITIES. 1: REVIEW AND EVALUATION OF MISSENARD METHOD Final Report, Nov. 1988 - Dec. 1989
Elwin C. Penski Jun. 1990 21 p
(DA Proj. 1C1-62622-A-5531)
(AD-A224161; CRDEC-TR-199) Avail: NTIS HC A03/MF A01 CSCL 07/3

The Missenard group contribution values are used to calculate heat capacities of 10 compounds for comparison with measured literature values. Comparisons are also made with Kopp's rule. Good agreement between literature and calculated values is obtained with the Missenard group contribution method. Group contribution values and the details of the calculations are provided. GRA

N90-29455# Princeton Univ., NJ.
CHEMICAL KINETIC AND AERODYNAMIC STRUCTURES OF FLAMES Annual Report, 1 Mar. 1989 - 28 Feb. 1990
C. K. Law 20 Jun. 1990 27 p
(Grant AF-AFOSR-0293-89; AF Proj. 2308)
(AD-A224281; AFOSR-90-0748TR) Avail: NTIS HC A03/MF A01 CSCL 21/2

During the reporting period extensive experimental and numerical studies on the dynamics and kinetics of laminar premixed and diffusion flames have been conducted. Specific problems investigated include dilution and temperature effects in soot formation in diffusion flames, chemical and physical effects of additives in soot formation, experimental determination of laminar flame speeds of ethane, ethylene, acetylene, propane and hydrogen mixtures with air and the partial validation of the associated kinetic mechanisms, the theoretical prediction and experimental determination of the flammability limits of a variety of combustible mixtures, and the determination of the dynamic and chemical kinetic structures of diffusion flames near extinction. GRA

N90-29456# Wisconsin Univ., Madison.
KINETIC PATHWAY IN STRANSKI-KRASTANOV GROWTH OF Ge ON Si(001)
Y. W. Mo, D. E. Savage, B. S. Swartzentruber, and M. G. Lagally 20 Apr. 1990 34 p
(Contract N00014-90-J-1119)
(AD-A224324; TR-5) Avail: NTIS HC A03/MF A01 CSCL 07/4

The transition from 2D to 3D growth of Ge on Si(001) was investigated with scanning tunneling microscopy. A metastable 3D cluster phase with well-defined structure and shape is found. The clusters have Ge lattice constants and a (105) facet structure. Results suggest that these clusters provide an easy kinetic path for formation of macroscopic Ge islands. GRA

N90-29457# Ohio State Univ., Columbus.
PROCEEDINGS OF THE 45th OHIO STATE UNIVERSITY SYMPOSIUM ON MOLECULAR SPECTROSCOPY Final Report
K. N. Rao 15 Jun. 1990 207 p Symposium held in Columbus, Ohio, 11-15 Jun. 1990
(Contract DAAL03-89-G-0020)
(AD-A224349; ARO-26430.2-PH-CF) Avail: NTIS HC A10/MF A01 CSCL 20/5

A book of abstracts was compiled by the University. Topics include: Clusters: Spectroscopy by Dissociation; Large-Amplitude Motions in Weakly Bound Complexes; Slit Jet Infrared Spectroscopy: Probing the Internal Dynamics of Weakly Bonded Molecular Complexes; Laser Spectroscopy of Exotic Chemical Species; Transient Weakly Bound, Reactive, and Surface Adsorbed Molecules. GRA

N90-29458# Cincinnati Univ., OH. Dept. of Chemistry.
ELECTROCHEMISTRY OF METAL SURFACES Final Technical Report, 1 Jul. 1986 - 30 Apr. 1990
Arthur T. Hubbard 30 Jun. 1990 55 p
(Grant AF-AFOSR-0200-86; AF Proj. 2373)
(AD-A224551; AFOSR-90-0838TR) Avail: NTIS HC A04/MF A01 CSCL 07/4

The essence of this project is investigation of the structure, composition, mode of attachment and reactivity of the surface molecular species which form when metals come into contact with fluids. A series of findings, advances in investigation technology and 91 scientific articles have occurred thus far during this project. These include: (1) determination of the orientations and modes of attachment of organic molecules attached to electrode surfaces; (2) demonstration that each orientation of an adsorbed molecule manifests different chemical and electrochemical reactivity; (3) discovery that electrodeposition of metals at single-crystal surfaces produces highly-ordered layers; (4) discovery that contact between metal surfaces and ionic solutions forms chemically unique, ordered layers; (5) adaptation of electron energy-loss spectroscopy (EELS) for measurement of vibrational spectra of molecules adsorbed at metal surfaces from solutions; (6) systematic study of 150 adsorbed phenols, acids, amines, pyridines, mercaptans, alcohols, alkenes and aromatics as a structure (LEED), composition (Auger), molecule construction/mode of surface attachment (EELS), chemical reactivity (all methods), and electro-chemical reactivity (cyclic voltammetry, CV); (7) demonstration of the stability of these adsorbed layers toward vacuum and electron beams used in

surface spectroscopy by performing CV before and after the electron spectra were obtained; and, (8) studies of surface structure by means of Auger electrons. GRA

N90-29459# University of Southern Mississippi, Hattiesburg. Dept. of Polymer Science.
SOLID-STATE N15 NMR OF N15-LABELED NYLON 6 AND NYLON 11 Technical Report No. 33, 1 Jun. 1989 - 31 May 1990
Lon J. Mathias, Douglas G. Powell, Jean-Philippe Autran, and Roger S. Porter (Massachusetts Univ., Amherst.) 22 May 1990 40 p Submitted for publication
(Contract N00014-89-J-1225)
(AD-A223271) Avail: NTIS HC A03/MF A01 CSCL 11/9

The solid state Nitrogen-15 nuclear magnetic resonance characterization of nylon 6 and nylon 11 is summarized and compared. The two compounds of the non-crystalline peak are thought to belong to a liquid-like amorphous region and a more rigid interphase region lying between the crystalline and amorphous regions. The chemical shift anisotropy (CSA) spectra of static samples were also obtained. Motion in the amorphous region was monitored by observing an isotropic peak at elevated temperatures. At temperatures above 100 deg for nylon 6, the most deshielded component was lost from the CSA spectrum suggesting a previously unreported motion occurring in the rigid crystalline region involving libration of the intermolecular hydrogen bond. For nylon 11, the alpha-crystal form transformed above 95 C to the pseudohexagonal delta-crystal form, although the CSA spectra showed that the hydrogen bonded amide units remained conformationally rigid despite increasing librational motion. GRA

N90-29460# Puerto Rico Univ., Rio Piedras. Dept. of Chemistry.
EFFECTS OF BASIS SET CONTRACTION IN RELATIVISTIC CALCULATIONS ON NEON, ARGON, AND GERMANIUM
Yasuyuki Ishikawa, Hideo Sekino, and R. C. Binning, Jr. (Argonne National Lab., IL.) 12 Jan. 1990 7 p Repr. from Chemical Physics Letters (North Holland, Netherlands, Elsevier Science Publishers), v. 165, no. 2,3, 12 Jan. 1990 p 237-242 Sponsored in part by NSF
(Contract DAAG29-85-G-0118)
(AD-A223357; ARO-22983.15-CH-H) Avail: NTIS HC A02/MF A01 CSCL 20/5

Calculations on neon, argon, and germanium have been performed with basis sets of contracted and uncontracted Gaussian-type functions. Both relativistic and non-relativistic Hartree-Fock and many-body perturbation theory calculations have been performed with the intent of observing to what extent basis set contraction affects calculated relativistic and correlation contributions to total atomic energy. It is found that even severe contraction has relatively little effect on calculated relativistic effects. Most non-relativistic molecular electronic structure calculations are done with basis sets of Gaussian-type functions (GTF). Multicenter integrals over GTF can be written in analytic form and may thus be evaluated faster and more accurately than can those integrals taken over exponential functions. Gaussians behave correctly at neither short nor long range, however, and it is necessary to use a greater expansion length of GTF, especially those which describe the region near the origin, than of exponential functions to attain the same accuracy. GRA

N90-29461# Massachusetts Univ., Amherst. Dept. of Chemistry.
THEORETICAL INVESTIGATIONS OF Pi-CONJUGATED POLYRADICALS AS MODELS FOR ORGANIC MAGNETIC MATERIALS Technical Report, period ending 1989
Paul M. Lahti 6 Mar. 1990 6 p Presented at the American Chemical Society Meeting, Boston, MA, Spring 1990 Submitted for publication Sponsored by Exxon Education Foundation
(Contract N00014-87-K-0464; NSF CHE-87-12319)
(AD-A223411; TR-15) Avail: NTIS HC A02/MF A01 CSCL 07/6

Pi-conjugated polyradicals are of interest as potential superparamagnetic species with possible uses as organic magnetic information storage materials. Experimental results to date suggest that simple parity-based qualitative models are not entirely successful in making global predictions of ground state (GS) spin multiplicity for various connectivity classes of organic polyradicals. We show that a variety of experimentally known diradicals are well described by a semiempirical MO-CI model based on AM1, and that our semiempirical approach gives predictions in good accord with ab initio work where experiments are yet to be performed. The use of such predictive algorithms is described in making rational selection of model compounds for testing spin-magnetic interactions in organic systems. GRA

N90-29462# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INTEGRATING RULE-BASED AND NEURAL-NET TECHNIQUES FOR SPECTRAL ANALYSIS M.S. Thesis
Arthur L. Sumner Jun. 1990 110 p
(AD-A223517; AFIT/GE/ENG/90J-01) Avail: NTIS HC A06/MF A01 CSCL 06/5

Spectral analysis involving the determination of atomic and molecular species present in multi-spectral data is a very time consuming task, especially considering the fact that there are typically thousands of spectra collected during each experiment. Due to the overwhelming amount of available spectral data and the time required to analyze these data, a robust automatic method for performing preliminary spectral analysis is needed. This research focused on the development of a rule-based expert system and a supervised artificial neural network with error correction learning, specifically a three-layer, feed-forward, back-propagation perceptron. The objective was to develop an integrated spectral analysis system which would perform preliminary spectral analysis and save the analysts from the task of reviewing thousands of spectral frames. The input to the neural network, which is screened by the rule-base, is raw spectral data, with the output consisting of the classification of both atomic and molecular species in the source. GRA

N90-29463# Sandia National Labs., Albuquerque, NM.
THERMOCHEMICAL DATA FOR SILICON-CONTAINING SPECIES FROM AB INITIO ELECTRONIC STRUCTURE CALCULATIONS
Pauline Ho and Carl F. Melius 1990 7 p Presented at the 11th International Conference on Chemical Vapor Deposition, Seattle, WA, 14-19 Oct. 1989
(Contracts DE-AC04-76DP-00789; F33615-89-C-5628)
(DE90-011024; SAND-90-0091C; CONF-901088-1) Avail: NTIS HC A02/MF A01

A combination of high-level ab initio electronic-structure calculations and empirical bond-additivity corrections are used to calculate thermochemical properties of gas-phase molecules. A self-consistent set of heats of formation for molecules in the SiH, Si--H--Cl, Si--H--F, Si--N--H and Si--N--H--F systems is presented. DOE

N90-29464# United Technologies Research Center, East Hartford, CT.
INVESTIGATION OF PARTICULATE FORMATION DURING DIESEL SPRAY COMBUSTION Technical Progress Quarterly Report, 1 Mar. - 31 May 1990
1990 7 p
(Contract DE-AC04-87AL-43058)
(DE90-012682; DOE/AL-43058/T3) Avail: NTIS HC A02/MF A01

The objective of the contract is to conduct an experimental and analytical research program to investigate strategies for using coherent anti-Stokes Raman scattering (CARS) laser diagnostic techniques for detecting the degree of fuel pyrolysis and determining fuel-air ratio. Smoke and NO(sub x) production rates depend in a complex way on the local temperature, the evaporation of the diesel spray, the local fuel-air ratio, and the pyrolysis history of the fuel. Furthering the ability of CARS to provide more of this information may give engine designers more insight into the

combustion process and allow them to create engines which produce fewer particulates or lower amounts of NO(sub x). Controlling the production rates is preferable to processing emissions. If they cannot both be suppressed simultaneously, adjusting the tradeoff between producing particulates or NO(sub x) may be helpful if an exhaust processing method is available for one of them. DOE

N90-29465# Brigham Young Univ., Provo, UT. Dept. of Chemistry.
SUPERCRITICAL FLUID CHROMATOGRAPHY/SUPERSONIC JET SPECTROSCOPY Final Report, 15 Sep. 1986 - 31 Dec. 1989
Steven R. Goates and Milton L. Lee 1989 37 p
(Contract DE-FG22-86PC-90534)
(DE90-015220; DOE/PC-90534/15) Avail: NTIS HC A03/MF A01

Supersonic jet spectroscopy (SJS) was successfully coupled to supercritical fluid chromatography (SFC) and developed as high resolution technique for the analysis of complex samples. Direct supersonic expansion of the supercritical fluid was shown to be compatible with micro-bore and larger column SFC; high pressure sheath-flow expansions allowed capillary SFC to be performed with SJS. Selective, sensitive detection was demonstrated with both techniques for a coal tar sample. Design and characterization of nozzle performance was an important effort in the development of the SFC/SJS technique, including study of the direct expansion process, modification of the sheath-flow approach to make it applicable to supercritical fluid experiments, testing of several variations of pulsed nozzles, and investigation of back-pressure regulation of flow in capillary SFC to improve efficiency and resolution. Finally, improvements to signal detection and alternative detection schemes were investigated in efforts to enhance sensitivity and information content of the measurement. Perylene and benzo(a)pyrene were selectively detected in a coal tar samples at detection limits of 0.5 ng and 40 ng, respectively. Back-pressure regulation of eluent flow using the sheath-flow nozzle was investigated as a means of control in capillary SFC. Pre-restrictor detection was employed in the evaluation of the effect of regulated flow on chromatographic separations. Chromatographic resolution was improved when a constant linear velocity was maintained. DOE

N90-29466# California Univ., Berkeley. Lawrence Berkeley Lab.
CYCLIC VOLTAMMETRY AT A ROTATING DISK, ELECTROREDUCTION OF NITRATE IN ACIDIC NICKEL SOLUTIONS, AND FREQUENCY-RESPONSE ANALYSIS OF POROUS ELECTRODES Ph.D. Thesis
Paul Mark Shain Jun. 1990 227 p
(Contract DE-AC03-76SF-00098)
(DE90-015317; LBL-29118) Avail: NTIS HC A11/MF A02

Models of electrochemical systems were developed to interpret experimental results. Linear sweep voltammetry and frequency-response analysis (electrochemical impedance spectroscopy) were the experimental techniques considered; the reduction of nitrate in acidic nickel solutions and the frequency response of redox couples in porous electrodes, the electrochemical systems. Linear sweep voltammetry was used to study the kinetics of nitrate reduction acidic nickel solutions. This is a step in the manufacture of nickel battery electrodes and would also be important in the corrosion of steel by nitric acid. The reaction is interesting because negative ions react at the negative electrode. Bernardi studied this reaction with potential step and linear sweep voltammetry experiments. The voltammetry model was developed to explain the results of the latter. It was based on earlier work by Matlosz and Newman but allows for the participation of adsorbed species in the reactions. The assumption of a stagnant-diffusion layer was relaxed. The model accounts properly for the beginning of the sweep before the boundary layer develops. DOE

N90-29467# Johns Hopkins Univ., Baltimore, MD.
STATISTICALLY DESIGNED STUDY OF THE VARIABLES AND PARAMETERS OF CARBON DIOXIDE EQUATIONS OF STATE
Marc D. Donohue, Douglas Q. Naiman, Jin Gang, and Joseph R. Loehe 15 Apr. 1990 95 p
(Contract DE-AC22-89BC-14200)
(DE90-016196; DOE/BC-14200/T1) Avail: NTIS HC A06/MF A01

Carbon dioxide is used widely in enhanced oil recovery (EOR) processes to maximize the production of crude oil from aging and nearly depleted oil wells. Carbon dioxide also is encountered in many processes related to oil recovery. Therefore, accurate representations of the properties of carbon dioxide, and its mixtures with hydrocarbons, play a critical role in a number of enhanced oil recovery operations. One of the first tasks of this project is to select an equation of state to calculate the properties of carbon dioxide and its mixtures. In doing this, we have taken into account the equation's simplicity, accuracy, and reliability in representing phase behavior and thermodynamic properties of mixtures containing carbon dioxide with hydrocarbons at conditions relevant to enhanced oil recovery. We also have determined the thermodynamic properties that are important to enhanced oil recovery and the ranges of temperature, pressure and composition that are important. Twelve equations of state were chosen for preliminary studies to be evaluated against these criteria. All of these equations were tested for pure carbon dioxide and eleven were tested for pure alkanes and their mixtures with carbon dioxide. Equations were selected for detailed statistical analysis. DOE

N90-29468# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
EXAMINATIONS OF HYPERFINE STRUCTURE AND ISOTOPE DISPLACEMENT OF THE ELEMENTS GADOLINIUM AND EUROPIUM WITH LASER FLUORESCENCE AND TWO PHOTON SPECTROSCOPY Ph.D. Thesis [UNTERSUCHUNGEN ZUR HYPERFEINSTRUKTUR UND ISOTOPIEVERSCHIEBUNG DER ELEMENTE GADOLINIUM UND EUROPIUM MIT TECHNIKEN DER LASERFLUORESZENZ - UND ZWEIPHOTONENSPEKTROSKOPIE]
Dieter-Juergen Weber 1989 203 p In GERMAN
(ETN-90-97312) Avail: NTIS HC A10/MF A02

The mechanical structure and the utilization of a commercial color ring laser system for laser spectroscopy are discussed and the development of a pressure estimation of the laser system for linearity improvement is examined. The possibilities of a thermoionic diode for ion detection of the two photon absorption from the fundamental state for temperatures lower than 1200K were considered. Spectral measurements of the hyperfine structure of gadolinium and europium were carried out with optogalvanic spectroscopy, particularly in the case of a given multiplet configuration. Thirty energy levels were investigated for each orbital moment. The electron separation factors and the quadrupole moments are evaluated. ESA

N90-29469# Freie Univ., Berlin (Germany, F.R.). Fachbereich Physik.
AN ELECTRON SPIN RESONANCE STUDY OF ADSORBED GASES IN ULTRAHIGH VACUUM Ph.D. Thesis [EINE ELEKTRONENSPINRESONANZ-STUDIE AN ADSORBIERTEN GASEN IM ULTRAHOCHVAKUUM]
Michael Zomack 1987 116 p In GERMAN Sponsored by DFG
(ETN-90-97323) Avail: NTIS HC A06/MF A01

An experimentally realized device allows combination of modern surface analysis and preparations in ultra high vacuum with the electron spin resonance in situ. The magnetic gases O2, NO, NO2 were adsorbed on clean metal surfaces (Ag, Cu, Pt) at several temperatures. No electron spin resonance signal was remarked, perhaps because light elements cannot be adsorbed on a metal by a conventional electron spin resonance because of the interaction between the magnetic valence shell of an adsorbate and the power electrons. A hyperfine electron spin resonance spectrum was found by adsorption of NO2 molecules on the surface

of gas films (Argon, Krypton, Xenon) on a metallic substrate and the 4a1 molecular orbital of NO2 was obtained. The line and the signal intensity were analyzed and the degree of dimerization of N2O4 was obtained. ESA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N90-29470*# Clarkson Univ., Potsdam, NY. School of Engineering.
INFLUENCE OF CONVECTION ON MICROSTRUCTURE Semiannual Progress Report, 15 Aug. 1989 - 14 Feb. 1990
William R. Wilcox, Rubens Caram, A. P. Mohanty, and Jayshree Seth 1990 77 p
(Grant NAG8-753)
(NASA-CR-186506; NAS 1.26:186506) Avail: NTIS HC A05/MF A01 CSCL 11F

The mechanism responsible for the difference in microstructure caused by solidifying the MnBi-Bi eutectic in space is sought. The objectives for the three year period are as follows: (1) completion of the following theoretical analyses - determination of the influence of the Soret effect on the average solid composition versus distance of off-eutectic mixtures directionally solidified in the absence of convection, determination of the influence of convection on the microstructure of off-eutectic mixtures using a linear velocity profile in the adjacent melt, determination of the influence of volumetric changes during solidification on microconvection near the freezing interface and on microstructure, and determination of the influence of convection on microstructure when the MnBi fibers project out in front of the bismuth matrix; (2) search for patterns in the effect of microgravity on different eutectics (for example, eutectic composition, eutectic temperature, usual microstructure, densities of pure constituents, and density changes upon solidification); and (3) determination of the Soret coefficient and the diffusion coefficient for Mn-Bi melts near the eutectic composition, both through laboratory experiements to be performed here and from data from Shuttle experiments. Author

N90-29471# National Inst. of Standards and Technology, Gaithersburg, MD. Metallurgy Div.
MECHANICAL PROPERTIES AND FRACTURE TOUGHNESS OF AAR-TC128 GRADE B STEEL AND A MICRO-ALLOYED, CONTROL-ROLLED STEEL, A 8XX GRADE B, FROM -80F TO +73F
G. E. Hicho and J. H. Smith Apr. 1990 45 p Sponsored by Federal Railroad Admin., Washington, DC
(PB90-207796; NISTIR-90/4289; Rept-19) Avail: NTIS HC A03/MF A01 CSCL 11F

Mechanical property and fracture toughness tests were conducted on two steels from -80 F to +73 F. The two steels examined were normalized and inclusion shape controlled AAR (Association of American Railroads) TC128 grade B steel and control-rolled and inclusion shape controlled A 8XX grade B steel. The tensile properties of the A 8XX steel were better than a A 8XX steel. However, the notch toughness, as determined by Charpy V-notch, nondestructive test temperature, and J-integral tests, of the AAR TC 128 grade B steel was better than that of the A 8XX grade B steel. Unstable cleavage fracture was the predominate mode of failure of the A 8XX steel at low test temperatures. Metallographic investigations also showed that the ferrite/pearlite grain size of the AAR TC128 steel was more uniform and finer than that of the A 8XX steel. GRA

N90-29472# Pacific Northwest Lab., Richland, WA.
SWELLING OF NEUTRON IRRADIATED VANADIUM ALLOYS
B. A. Loomis, D. L. Smith (Argonne National Lab., IL.), and F. A. Garner Jun. 1990 8 p Submitted for publication
(Contracts DE-AC06-76RL-01830; W-31-109-eng-38)
(DE90-015294; PNL-SA-17175) Avail: NTIS HC A02/MF A01

The swelling of V-10.0Cr-0.1Al, 1Cr-0.3Al, V-3.1Ti-0.3Si, V-4.9Ti, V-14.4Ti, V-17.7Ti, V-20.0Ti, V-14.4Cr-0.3Ti-0.3Al, V-14.1Cr-1.0Ti-0.3Al, V-13.7Cr-4.8Ti, V-9.0Cr-3.3Fe-1.2Zr (Vanstar-7), V-14.5Ti-7.2Cr, V-8.6W, V-4.0Mo, and V-12.3 Ni alloys and unalloyed V was determined after neutron irradiation at 420 and 600 C to irradiation damage levels ranging from 17 to 77 dpa in the FFTF-MOTA reactor facility. The swelling of these alloys was obtained from a determination of the density for the unirradiated and irradiated alloys on immersion in CCl4. The swelling of unalloyed V at 600 C was substantially increased by the addition of Cr. The addition of either Ni, W, or Mo to V had relatively minor effect on the swelling of V. The swelling of the V-Cr-Ti alloys was strongly dependent on the Ti concentration. The swelling of the V-3.1Ti-0.3Si and V-14.4Ti alloys at 600 C was greater than that exhibited by the other binary V-Ti alloys. The Vanstar-7 alloy underwent larger swelling that the V-Ti and V-Cr-Ti alloys. For the binary V-Ti alloys and the ternary V-Cr-Ti alloys, the dependence of swelling on the amount of irradiation damage was less than 0.1 percent swelling per dpa. DOE

N90-29473# International Centre for Theoretical Physics, Trieste (Italy).
ON HYDROGEN CHEMISORPTION ON METALS: THE ELECTRON CORRELATION EFFECTS
R. Taranko, R. Cardenas, E. Taranko, and V. K. Fedyanin (Joint Inst. for Nuclear Research, Dubna, USSR) Dec. 1989 14 p
(DE90-627318; IC-89/417) Avail: NTIS (US Sales Only) HC A03/MF A01

Within the composite Anderson-Ising Hamiltonian method the coverage dependence of the adatom charge and the adatom local density of states were investigated. The electron intra-atomic Coulomb correlations on the adatom were included up to the second order in V (the single particle hopping strength between the adatom and the substrate) using the Bragg-Williams approximation for the ionic adsorbate component. For a model system describing hydrogen chemisorption on cubium were obtained values of the adatom charge smaller than the corresponding ones calculated within the Hartree-Fock approach and the second-order self-matrix formalism of Brenig and Schonhammer. DOE

N90-29474# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
RESEARCH ON MERCURY CADMIUM TELLURIDE Final Report, 15 Feb. 1985 - 14 Feb. 1990
Sorab K. Ghandhi and Ishwara B. Bhat 9 Jul. 1990 19 p Sponsored by IBM and Raytheon Corp.
(Contract N00014-85-K-0151)
(AD-A224250) Avail: NTIS HC A03/MF A01 CSCL 11/6

Work done over a five-year period is summarized for a program entitled, Research on Mercury Cadmium Telluride. Using the alloy growth OMVPE process, compositional uniformity of 0.005 over a 2 GaAs slice was obtained. A p-type doping to 10(exp 17)cu cm and n-type doping to 4 x 10(exp 18)/cu cm was achieved using As and In respectively. Annealing studies have shown that the background concentration of undoped HgCdTe is around 5 x 10(exp 14)/cu cm. Passivation techniques, using anodic sulfidization, were developed for HgCdTe. Both p-n diodes and field effect transistors were demonstrated on material grown during the course of this program. A diffusion length of 120 microns was measured in material with x = 0.3. GRA

N90-29475# Rockwell International Science Center, Thousand Oaks, CA.
PROCESSABILITY AND HIGH TEMPERATURE BEHAVIOR OF EMERGING AEROSPACE ALLOYS Final Report, 1 May 1986 - 28 Feb. 1990
C. Ghandhi, A. K. Ghosh, and C. G. Rhodes Jun. 1990 102 p
(Contract F49620-86-C-0058)
(AD-A224285; SC5459.FR; AFOSR-90-0745TR) Avail: NTIS HC A06/MF A01 CSCL 11/6

A model for subgrain superplasticity was developed. Aluminum alloys that contain low angle boundaries exhibit different superplastic behavior than alloys consisting of high angle

boundaries. On a relative basis, the low angle boundaries increase the flow stress but impart a greater resistance to cavitation; the strain-rate sensitivity of this material is generally smaller and the change in the strain-rate sensitivity with strainrate shows a minimum instead of a maximum as observed in the large angle boundary materials. As a result, the subgrain material can be deformed to a large tensile strains at fast strain rates. A kinetic model for subgrain superplasticity that invokes a balance between the arrival and emission rates of disclosure at low angle boundaries is presented. It explains several features of subgrain superplasticity. It also explains why ultrafine dispersoids of intermetallics appear to stabilize the subgrain structure in aluminum. Early work on the correlation between flow stress and subgrain size in dynamic recrystallization of metals may also be consistent with the model. GRA

N90-29476# Barcelona Univ. (Spain).
PROCEEDINGS OF A DISCUSSION MEETING ON THERMODYNAMICS OF ALLOYS Abstracts Only
26 May 1990 54 p Meeting held in Sant Feliu de Quixols, Spain, 23-26 May 1990
(Contract DAJA45-90-M-0273)
(AD-A224336; R/D-6379-MS-02) Avail: NTIS HC A04/MF A01 CSCL 20/13

The study of the thermodynamics of vaporization reactions by high-temperature techniques has always been motivated in part by the realization that the nature of the reactants and products in such reactions cannot always be inferred from measurements made on quenched samples and at lower temperatures. This is true for condensed phases as well as for the vapor species. In particular, the occurrence of solids with wide ranges of homogeneity can change the character of the net vaporization reactions. In order to determine the nature of such reactions, methods were devised which provide information about partial and total pressures at temperature including Knudsen-effusion mass-spectrometric, torsion-effusion and mass-loss effusion. In our laboratory mass-loss and mass-spectrometric measurements are made simultaneously to provide a uniquely powerful tool for the study of incongruent, as well as congruent, vaporizations. GRA

N90-29477# Army Armament Research, Development and Engineering Center, Watervliet, NY. Close Combat Armaments Center.
EFFECTS OF LOW CHROMIUM(3) CONCENTRATION IN ELECTRODEPOSITION OF LOW CONTRACTION CHROMIUM Final Report
M. D. Miller and S. K. Pan Apr. 1990 20 p
(DA Proj. 1A9-3Z9-CANMSC)
(AD-A223338; ARCCB-TR-90014) Avail: NTIS HC A03/MF A01 CSCL 07/4

The effects of low chromium (Cr) (III) concentrations on the electrodeposition of low contraction (LC) chromium were studied. A systematic experiment was performed with a Cr (III) concentration range of 0.8 to 10.2 g/1 and the following standard LC plating parameters: 250-g/1 chromic acid solution, 97-A/dm2 current density, and 85 C bath temperature. On the basis of mechanical properties and the microstructure of the deposits, it was found mechanical properties and the microstructure of the deposits, it was found that lower Cr(III) concentrations yielded higher hardness values, lower tensile strengths, and decreased current efficiencies. The grain size of the deposits also became larger as the Cr(III) concentration decreases. GRA

N90-29478# Idaho National Engineering Lab., Idaho Falls.
INVESTIGATION OF WELD BEAD COOLING RATE DURING STARTUP OF GAS METAL ARC WELDING Annual Report, Oct. 1988 - Sep. 1989
H. B. Smartt, H. L. Brown, and R. A. Morris Mar. 1990 46 p
(Contract N00167-88-WR-80059)
(AD-A223567; EGG-MS-8945) Avail: NTIS HC A03/MF A01 CSCL 11/6

Most rejectable gas metal arc weld defects occur during weld initiation. Such defects are probably caused by nonequilibrium thermal conditions during weld startup which result in higher than normal weld bead cooling rates. This report describes experimental studies to investigate the feasibility of decreasing the initial weld bead cooling rate. A control model that allows independent setting of weld heat and mass input was used in combination with a proportional-integral controller. Startup and steady-state weld bead cooling rates have been established for a range of heat inputs. The controller was then used to delay welding torch movement for 4 s, and to apply a higher than normal heat input during the first 7 s of the weld. Heat input was then reduced to a predetermined lower value while maintaining constant mass input. The combination of delayed torch movement and 12.5 percent higher initial heat input reduced the weld bead cooling rate by at least 40 percent during weld startup. Present results confirm the feasibility of modifying the initial weld bead cooling rate by appropriate combinations of equipment operating parameters, but an extra heat source is needed to achieve an initial cooling rate equal to the subsequent steady-state rate. GRA

N90-29479# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
THE ROLES OF STRAIN AND REHEATING INTERVAL IN CONTINUOUS RECRYSTALLIZATION DURING THE THERMOMECHANICAL PROCESSING BY WARM ROLLING OF AN Al-Mg ALLOY M.S. Thesis
Thomas E. Gorsuch Dec. 1989 79 p
(AD-A223673) Avail: NTIS HC A05/MF A01 CSCL 11/6

Investigation into the influence of rolling strain and into the variation of properties and structure during reheating intervals between rolling passes in the thermomechanical processing of an Aluminum-9.89 Magnesium-0.09 Zirconium alloy (composition in weight percent) was conducted. Superplastic ductilities up to approximately 1120 percent were achieved by processing to a total strain of 2.5 utilizing a reheating interval of 30 minutes. Conversely, rolling to lesser values of strain with the same reheating interval or rolling to a strain of 2.5 and using a 5 minute reheating interval produced ductilities less than 400 percent. A strong correlation was demonstrated between results achieved and a qualitative model for continuous recrystallization during thermomechanical processing previously proposed. GRA

N90-29480# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
THE STRESS AND TEMPERATURE DEPENDENCE OF CREEP IN AN Al-2.0 WT PERCENT Li ALLOY M.S. Thesis
Earl F. Goodson, Sr. Dec. 1989 130 p
(AD-A223676) Avail: NTIS HC A07/MF A01 CSCL 11/6

The effect of stress and temperature on the creep behavior of an Aluminum-2.0 wt percent Lithium alloy was investigated in the temperature range from 300 to 500 C. This temperature interval corresponds to a solid solution of Li in Al. Experimental results indicate that Al-2.0 wt percent Li behaves as a pure metal class alloy (class II). This is demonstrated by several creep characteristics including the value of the stress exponent (n approx. 5), the shape of the creep curve, and the nature of the creep transient after a temperature change. However, anomalous behavior of the activation energy was observed. Activation energies up to 55 kilocalories per mole, decreasing to approximately 33 kcal/mole at higher temperatures, were observed by the temperature cycling technique. GRA

N90-29481# Sandia National Labs., Albuquerque, NM.
A WELDING METALLURGY STUDY OF HASTELLOY ALLOYS B-2 AND W
T. J. Lienert, C. V. Robino, C. R. Hills, and M. J. Cieslak 1990 7 p Presented at the ASM Fall Meeting, Detroit, MI, 6-12 Oct. 1990
(Contract DE-AC04-76DP-00789)
(DE90-011910; SAND-90-1335C; CONF-901095-1) Avail: NTIS HC A02/MF A01

The weldability, solidification behavior, and solidification microstructures of Hastelloy B-2 and Hastelloy W have been investigated. Susceptibility to fusion zone hot-cracking was

determined by autogenous Varestraint testing. High temperature phase transformations, including solidification events, were identified by differential thermal analysis (DTA). After testing, the microstructures of various specimens were examined by optical metallography, scanning electron microscopy (SEM), electron microprobe analysis, and analytical electron microscopy (AEM). Results of this study showed that Hastelloy B-2 has exceptional resistance to hot cracking, comparable to that of Hastelloy C-4 and 304 stainless steel, while Hastelloy W proved to be somewhat more susceptible to hot cracking, exhibiting behavior similar to Alloy 625. The solidification process in both Hastelloy B-2 and Hastelloy W was found to be dominated by the segregation of Mo which gives rise to the formation of terminal eutectic-like constituents. This pattern of segregation is consistent with that of previous work on other Ni--Mo--Cr alloys. The microstructural constituents associated with hot-cracking in each alloy have been identified. DOE

N90-29482# Lawrence Livermore National Lab., CA.
THE INFLUENCE OF SOLIDIFICATION RATE ON SOLUTE REDISTRIBUTION AND SECOND-PHASE FORMATION IN STAINLESS STEEL ALLOYS
J. W. Elmer, T. W. Eagar, and S. M. Allen (Massachusetts Inst. of Tech., Cambridge.) 30 May 1990 5 p Presented at the 1990 American Society of Metals Week Materials Weldability Symposium, Detroit, MI, 6-12 Oct. 1990
(Contract W-7405-eng-48)
(DE90-015189; UCRL-JC-104189; CONF-9010159-1) Avail: NTIS HC A01/MF A01

Many common stainless steel (SS) alloy microstructures consist of a mixture of ferrite and austenite phases. However, when these alloys are rapidly resolidified using laser beam (LB) or electron beam (EB) processes, they solidify in the single-phase-austenite or single-phase-ferrite mode. This paper investigates the influence of solidification rate on the reduction, and eventual elimination, of second phases during the rapid solidification of Fe-Ni-Cr alloys. The influence of solidification rate on the ferrite content of these alloys was studied by calculating the dendrite-tip undercooling and then incorporating these results into a solute-redistribution model. The calculations and experiments agree semi-quantitatively, allowing the relative fractions of primary and secondary phases that solidify from the melt to be calculated for a wide range of solidification rates. DOE

N90-29483# Lawrence Livermore National Lab., CA.
SINGLE-PHASE SOLIDIFICATION DURING RAPID RESOLIDIFICATION OF STAINLESS STEEL ALLOYS
J. W. Elmer, T. W. Eager, and S. M. Allen (Massachusetts Inst. of Tech., Cambridge.) 30 May 1990 9 p Presented at the ASM Fall Meeting, Detroit, MI, 6-12 Oct. 1990 Submitted for publication
(Contracts W-7405-eng-48; N00014-80-C-0384)
(DE90-015190; UCRL-JC-104190; CONF-901095-5) Avail: NTIS HC A02/MF A01

The relative fractions of ferrite and austenite that solidify from a stainless steel (SS) alloy depend on the alloy composition and the solidification rate. Many common SS-alloy microstructures consist of a mixture of ferrite and austenite phases; however, when these alloys are rapidly resolidified using laser-beam (LB) or electron-beam (EB) processes, they solidify as single-phase austenite or single-phase ferrite. This paper investigates the influence of solidification rate on the reduction, and eventual elimination, of second phases during the rapid solidification of two Fe--Ni--Cr alloys. One alloy solidifies in the primary austenitic mode, and its ferrite content decreases to 0 percent with increasing solidification rate. The other alloy solidifies in the primary ferritic mode, and its ferrite content increases to 100 percent with increasing solidification rate. The influence of solidification rate on the ferrite content of these alloys was modeled by first calculating the dendrite-tip undercooling and then incorporating these calculations into a solute-redistribution model. The calculations and experiments agree semi-quantitatively, allowing the relative fractions of primary and secondary phases that solidify from the melt to be estimated for a wide range of solidification rates. The model predicts the minimum interface velocity for single-phase solidification to be about 40 mm/s, which correlates well with the experimental results for primary-austenite-solidified alloys but overestimates the minimum velocity for single-phase solidification of primary-ferrite-solidified alloys. DOE

N90-29484# Pacific Northwest Lab., Richland, WA.
RELATIONSHIP BETWEEN MICROSTRUCTURE, SPINODAL-LIKE DECOMPOSITION AND SELECTIVE ELECTROPOLISHING OF IRRADIATED INVAR-TYPE ALLOYS
J. M. McCarthy and F. A. Garner Jun. 1990 7 p Submitted for publication
(Contract DE-AC06-76RL-01830)
(DE90-015293; PNL-SA-17529) Avail: NTIS HC A02/MF A01

Energy dispersive x ray spectroscopy (EDX) analysis and selective electropolishing were used to study two specimens of Fe-35Ni irradiated with neutrons at 420 C and 520 C and one specimen of Fe-35Ni-15Cr irradiated at 510 C. Each was shown to be spinodally decomposed with the period of compositional oscillation appearing to decrease with decreasing irradiation temperature. When polishing conditions are used which promote etching, the low nickel micro-volumes are selectively attacked. The level of chromium appears to play no role in either the selective attack or the period of oscillation. The scale of surface irregularity and that of compositional oscillation appear to be identical but not related to the presence of currently existing microstructural components. DOE

N90-29485# Pacific Northwest Lab., Richland, WA.
TENSILE BEHAVIOR AND SWELLING OF TERNARY AUSTENITIC ALLOYS IRRADIATED IN DIFFERENT NEUTRON SPECTRA
M. L. Hamilton, F. A. Garner, and A. Okada Jun. 1990 14 p Submitted for publication
(Contract DE-AC06-76RL-01830)
(DE90-015295; PNL-SA-17145) Avail: NTIS HC A03/MF A01

Two nominally identical experiments designed to study the effects of nickel level, chromium level and helium generation rate on the microstructural development and tensile properties of Fe--Cr--Ni alloys are currently undergoing examination. One of these, conducted in the Oak Ridge Research Reactor (ORR) at higher He/dpa rate and a lower displacement rate compared to the other experiment in Experimental Breeder Reactor-II (EBR-II), shows substantially more strengthening and a different temperature range of swelling. The effect of irradiation temperature, neutron flux and neutron spectra appear to be larger than those of the compositional variations studied. Transmission electron microscopy (TEM) examination is in progress to determine the origin of the observed changes. DOE

N90-29486# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
SCANNING TUNNELING MICROSCOPY STUDIES OF CHEMISORBED LAYERS ON METAL SURFACES Thesis
David Mark Zeglinski (California Univ., Berkeley.) Apr. 1990 125 p
(Contract DE-AC03-76SF-00098)
(DE90-015623; LBL-28965) Avail: NTIS HC A06/MF A01

Scanning Tunneling Microscopy (STM) is introduced as a technique for surface studies by outlining the tunneling process, the instrument capabilities, and the experimental requirements. STM theory is summarized, beginning with a simple description of quantum tunneling. Metal-vacuum-metal junction theory is presented using Bardeen's transfer Hamiltonian formalism. Most STM imaging theory is based on this construct. A review of the theoretical work pertaining directly to STM concludes the summary. STM studies of adsorbates are introduced with a brief description of surface chemical bond classifications, adsorbate interactions and adsorbate concentration effects. Following this is a review of previous STM work done on metal surfaces in Ultra-High Vacuum (UHV). Since the structure of the metal surface itself influences adsorbate geometry, both clean and adsorbate covered surfaces

are discussed. The design and operation of a new STM is described. A review of other designs is presented for comparison. The microscope fits standard UHV systems as an add-on instrument. The techniques, Auger Electron Spectroscopy (AES), and Low Energy Electron Diffraction (LEED) are described since these surface sensitive methods are used to characterize the adsorbate systems studied. The surface structure of a graphitic carbon overlayer on a Pt(111) single crystal has been imaged with atomic resolution. The real space surface structure of the sulfur chemisorption series on Re(0001) surfaces has been imaged. While the saturation coverage structure passivates the surface and can be imaged in air, the sub-saturation coverage structures can only be studied in UHV. DOE

N90-29487# Montana State Univ., Bozeman.
OXIDATION OF NiAl(110) M.S. Thesis
Wade W. Brown Oct. 1989 68 p
(Contract DE-FG22-85PC-80518)
(DE90-015645; DOE/PC-80518/T13) Avail: NTIS HC A04/MF A01

The oxidation of nickel aluminium is a relatively unstudied process. A study is presented on the oxidation of nickel aluminum specifically the (110) surface. The oxidation was studied of NiAl(110), utilizing the following measurements: auger electron spectroscopy, x ray photoelectron spectroscopy, surface second harmonic generation, and work function change. It was found that oxygen is weakly incorporated on the NiAl(110) surface. The oxygen that is absorbed interacts with the aluminum in the substrate, exclusively, forming an aluminum oxide. Although, the oxide formed is geometrically or chemically different than Al2O3. There is little or no direct interaction between the nickel in the substrate and the adsorbed oxygen. Indirectly, the nickel effects the sticking coefficient, weakening the incorporation of the oxygen and the surface. The first stage of adsorption is surface followed by subsurface incorporation. The oxygen is bound weakly enough that the oxygen on the surface is desorbed when the exposure stops and a diffusion process causes the oxygen from the bulk to migrate to the surface region. DOE

N90-29488# Case Western Reserve Univ., Cleveland, OH. Dept. of Materials Science and Engineering.
INVESTIGATION OF THE EFFECTS OF MICROALLOY CONSTITUENTS, SURFACE TREATMENT AND OXIDATION CONDITIONS ON THE DEVELOPMENT AND BREAKDOWN OF PROTECTIVE OXIDE SCALES Final Report
K. Vedula 16 Apr. 1990 72 p Prepared for ORNL, TN
(Contract DE-AC05-84OR-21400)
(DE90-015710; ORNL/Sub-86-95900/02) Avail: NTIS HC A04/MF A01

Corrosion of materials in mixed gas environments at elevated temperatures is a problem in the fossil energy power generating industry. Mixed atmospheres containing oxygen and sulfur are particularly harmful in coal conversion systems. Considerable research on the causes, effects and prevention of different types of corrosion has been in progress over a long period of time. The thermodynamic and kinetic aspects of corrosion in mixed gas environments containing oxygen, as well as sulfur, have been studied quite extensively in recent years. Some of these studies are reported in references 1 to 16. However, a complete understanding of the basic mechanisms of degradation of oxide scales, particularly at low temperatures, is not available. Lower temperatures in the range of 500 to 700 C are of particular interest for many of the coal conversion equipments. The focus of the current program has been to obtain an understanding of the behavior of iron-based alloys in mixed oxygen and sulfur environments at these lower temperatures. The particular emphasis has been on the initial stages of development and breakdown of oxide scales in atmospheres containing high pS(sub 2)/pO(sub 2) ratios at temperatures in the range of 500 to 700 C. Fe-25 wt percent Cr, Fe-25 wt percent Cr-20 wt percent Ni and Fe-25 wt percent Cr-6 wt percent Al were the base alloys for this investigation. Of particular interest were the effects of reactive element additions Ce, Hf, La, Y through bulk alloying as well as through ion implantation and the effects of surface modification through peroxidation. DOE

N90-29489# Rochester Univ., NY.
TRANSITION METAL ACTIVATION AND FUNCTIONALIZATION OF CARBON-HYDROGEN BONDS Progress Report, 1 Dec. 1989 - 30 Nov. 1990
William D. Jones Jul. 1990 20 p
(Contract DE-FG02-86ER-13569)
(DE90-015826; DOE/ER-13569/5) Avail: NTIS HC A03/MF A01

The fundamental thermodynamic and kinetic factors that influence carbon-hydrogen bond activation at homogeneous transition metal centers are investigated. The project is also directed toward the conversion of hydrocarbons into functionalized products of potential use to chemical industry. Advances were made in both understanding the interactions of hydrocarbons with metals and in the functionalized of hydrocarbons. Major advanced that were made include: (1) It was found that RhCl(PR3)2 (CNR) complexes can catalyze the insertion of isonitriles into the C-H bonds of arenes upon photolysis; (2) Reactions were examined of a series of arenes with (C5Me5)Rh(PMe3)PhH and the kinetic and thermodynamic preferences were mapped for arene coordination; (3) The reactions were examined of rhodium pyrazolylborates for isonitrile functionalization of C-H bonds; (4) Studies were completed of the reactions of (C5Me5)Rh(PMe3)H2 with D2 and PMe3 that indicate that both eta sup 5 yields eta sup 3 ring slippage and metal to ring hydride migration occur more faciley than reductive elimination of H12; and (5) The reactions were examined of heterocycles with (C5Me5)Rh(PMe3)-PhH and found that pyrrole and furan undergo C-H or N-H activation. DOE

N90-29490# Oak Ridge National Lab., TN. Metals and Ceramics Div.
ALLOY DESIGN OF ORDERED INTERMETALLICS
E. P. George and C. T. Liu 1990 20 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC05-84OR-21400)
(DE90-016031; CONF-900466-80) Avail: NTIS HC A03/MF A01

Ordered intermetallics based on aluminides and silicides constitute a unique class of metallic materials promising high-temperature properties. However, brittle fracture and poor ductility limited their use as engineering materials in most cases. During the past ten years extensive research has been conducted on ordered intermetallics. As a result, significant progress has been made in identifying various causes of brittle fracture, and their relative importance in different ordered alloys. In some cases this understanding has helped achieve dramatic improvements in ductility. We review here three different classes of brittle fracture in ordered intermetallics and discuss the results in terms of model alloy systems chosen from each class. Ni(sub 3)Al and NiAl are discussed as prototypical ordered alloys prone to intrinsic intergranular brittleness. They are used to review our current understanding of intrinsically weak grain boundaries and the mechanisms by which boron is thought to suppress intergranular fracture. Next, FeAl and Fe3Al are discussed as examples of ordered intermetallics that are susceptible to environmental embrittlement at ambient temperature. Recent discoveries in these two alloy systems are reviewed with special emphasis on some of the rather interesting but subtle effects of test environment. Finally, Al3X type intermetallic (Al3 Sc, Al3 Ti-base, and Al3 Zr-base alloys) are discussed as examples of ordered alloys that have high symmetry (Ll(sub 2) structure), are relatively soft, yet cleave transgranularly with very little ductility. In all these cases, experimental results are compared with theoretical calculations. DOE

N90-29491# Oak Ridge National Lab., TN.
MULTIAXIAL FATIGUE CRITERION FOR 2-1/4 Cr-1 Mo STEEL FOR USE IN HIGH-TEMPERATURE STRUCTURAL DESIGN
J. J. Blass 1990 8 p Presented at the ASME/IEEE Joint Power Generation Conference, Boston, MA, 21-25 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE90-016039; CONF-901034-1) Avail: NTIS HC A02/MF A01

An improved multiaxial fatigue failure criterion is described that is based on a definition of equivalent inelastic strain range incorporating the shear and normal components of inelastic strain range on the planes of maximum inelastic shear strain range. Optimum values of certain parameters contained in the formulation were obtained by the method of least squares from the results of combined axial-torsional strain cycling test of 2--1/4 Cr-1 Mo steel conducted at 538 C (1000 F). The ability of this criterion to correlate the test results was compared with that of the Mises equivalent inelastic strain range criterion and was found to be superior. A procedure is described for calculating the required shear and normal components of strain range under general multiaxial strain cycling conditions. An improved definition of equivalent total strain range based on these considerations is directly applicable to the method of estimating fatigue damage in ASME Code Case N-47. DOE

N90-29492# Pennsylvania Univ., Philadelphia.
ATOMISTIC STUDIES OF GRAIN BOUNDARIES IN ALLOYS AND COMPOUNDS Progress Report, 1 Jul. 1989 - 30 Jun. 1990
V. Vitek 2 May 1990 22 p
(Contract DE-FG02-87ER-45295)
(DE90-012401; DOE/ER-45295/3) Avail: NTIS HC A03/MF A01

The main goal of this research project has been to investigate theoretically the atomic structure of gain boundaries in binary alloys, both discovered and ordered, and contribute thus to our understanding of atomic level processes affecting mechanical properties of polycrystalline materials. In particular, we concentrate on those structural features which distinguish boundaries in alloys from those in pure metals, and which might be responsible for remarkable differences in their fracture behavior. Atomistic computer modeling of grain boundaries is the principal technique employed in this project. However, such calculations are only meaningful if adequate descriptions of interatomic forces are available. For pure elements a wide variety of such descriptions have been developed in recent years but much less has been done for alloys. For this reason a large component of this research has been the development of such descriptions and two different approaches have been pursued. In this report we first summarize constructions of N-body potentials for alloys and describe briefly the present status of the development of the Linear Muffin-Tin Orbital (LMTO) based tight-binding technique. Studies of grain boundaries, summarized in this report, concentrated on two problems: segregation to grain boundaries in the copper-bismuth system and boundaries in L1(sub 2) compounds. In the former case the structural changes induced by segregation as well as conditions for saturation and faceting of the boundaries were investigated. In the latter case we focused on the relationship between the strength of ordering and the boundary structure. Significant differences which may be responsible for distinct fracture properties of pure metals, weakly ordered and strongly ordered compounds, have been found. DOE

N90-29493# Oak Ridge National Lab., TN.
THE USE OF AUTOMATED BALL INDENTATION TESTING TO MEASURE FLOW PROPERTIES AND ESTIMATE FRACTURE TOUGHNESS IN METALLIC MATERIALS
Fahmy M. Haggag, Randy K. Nanstad, John T. Hutton, David L. Thomas, and Ronald L. Swain 1989 45 p Presented at the ASTM Symposium on the Applications of Automation Technology To Fatigue and Fracture Testing, Kansas City, KS, 22-23 May 1989 Sponsored in part by Nuclear Regulatory Commission
(Contract DE-AC05-84OR-21400)
(DE90-015797; CONF-8905112-4) Avail: NTIS HC A03/MF A01

A field indentation microprobe (FIM) apparatus was developed (and patented) to evaluate, nondestructively in situ, the integrity of metallic structures. This study investigated the applicability of using a new automated ball indentation (ABI) test, which is a major part of the FIM, to measure the flow properties of metallic materials including those exhibiting Lueders or inhomogeneous strains (carbon steels, titanium alloys, aluminum alloys, etc.) and to estimate their fracture toughness. The ABI test is based on multiple indentations (at the same penetration location) of a polished metallic surface by a spherical indenter. Automation of the test, where a computer and test controller were used in innovative ways to control the test as well as to analyze test data, made it simple, rapid, accurate, economical, and reproducible. Results of ABI tests on different metals, welds, and irradiated materials are presented and discussed in this paper. Excellent agreement was obtained between ABI-derived data and those from standard ASTM uniaxial tensile and fracture toughness tests. DOE

N90-29494# Brookhaven National Lab., Upton, NY.
RECENT PROGRESS IN ELECTRONIC STRUCTURE CALCULATIONS FOR DEFECTS IN METALS
R. Zeller, B. Drittler, P. H. Dederichs, U. Klemradt (Institut fuer Festkoerperforschung Kernforschungsanlage, Juelich, Germany, F.R.), M. Weinert, and M. Doyama, ed. 1990 6 p Presented at the International Conference and Exhibition on Computer Applications To Materials Science and Engineering: Computer-Aided Innovation of New Materials, Tokyo, Japan, 28-31 Aug. 1990
(Contract DE-AC02-76CH-00016)
(DE90-016323; BNL-44939; CONF-900883-1) Avail: NTIS HC A02/MF A01

We describe recent progress in first-principles calculations of total electronic energies for vacancies and impurities in metals. The calculations are based on density-functional theory in the local-spin-density approximation and on full-potential multiple-scattering theory. We present results for vacancy formation, impurity solution and interaction energies which agree well with available experimental data. DOE

N90-29495# Pacific Northwest Lab., Richland, WA.
ISOTOPIC TAILORING AND OTHER TECHNIQUES USED TO STUDY HELIUM EFFECTS IN AUSTENITIC ALLOYS
F. A. Garner, M. L. Hamilton, J. F. Stubbins, N. Sekimura, and H. Kawanishi (Tokyo Univ., Japan) 1990 12 p Presented at the International Conference on Radiation Material Science, Alushta, USSR, 22-25 May 1990
(Contract DE-AC06-76RL-01830)
(DE90-016344; PNL-SA-17896; CONF-9005247-3) Avail: NTIS HC A03/MF A01

A review is presented of the early results of several related studies designed to explore in simple Fe-Cr-Ni alloys the influence of helium/dpa ratio in competition with other important material and environmental variables at 330 to 600 C. While helium at fusion-relevant levels influences the details of the microstructure somewhat, the resultant changes in macroscopic properties such as swelling and tensile behavior are relatively small. However, when greater-than-fusion levels of helium are generated, an extensive refinement of microstructure occurs, leading to depression of swelling at lower temperatures and increased strengthening at all temperatures studied. DOE

N90-29496# Pacific Northwest Lab., Richland, WA.
THE EFFECT OF HELIUM ON MICROSTRUCTURAL EVOLUTION IN AUSTENITIC STEELS AS DETERMINED BY SPECTRAL TAILORING EXPERIMENTS
N. Sekimura, F. A. Garner, and R. D. Griffin (Wisconsin Univ., Madison.) Jun. 1990 14 p Presented at the 15th Symposium on Effects of Radiation on Materials, Nashville, TN, 17-21 Jun. 1990
(Contract DE-AC06-76RL-01830)
(DE90-016360; PNL-SA-17804; CONF-900623-15) Avail: NTIS HC A03/MF A01

Fe-15Cr-XNi alloys irradiated at both low (0.66 to 1.2) and very high (27 to 58) helium/dpa levels exhibit significantly different levels of strengthening due to an unprecedented refinement of cavity microstructure at the very high helium levels. When compounded with the nickel dependence of helium generation, the cavity distribution for some irradiation conditions and alloy compositions can be driven below the critical radius for bubble to void conversion, leading to a delay in swelling. DOE

N90-29497# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifiques des Materiaux.
FUNDAMENTAL STUDIES ON INTERMETALLIC COMPOUNDS [ETUDES FONDAMENTALES SUR LES COMPOSES INTERMETALLIQUES]
G. Hug, A. Loiseau, F. Ducastelle, C. Bontemps, P. Caron, and T. Khan Oct. 1989 37 p In FRENCH
(Contract DRET-88-34-001)
(ONERA-RT-4/1855-M; ETN-90-97561) Avail: NTIS HC A03/MF A01

Investigations on DO sub 22 structure type compounds and on the mechanical behavior of a monocrystal of Ni3Al intermetallic compound are reported. Compression tests are performed on TiAl3 polycrystals between 25 and 800 C and the results are discussed. Monotonic compression tests on monocrystals Ni3Al alloy containing HI are carried out between 25 and 950 C. ESA

N90-29498# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique des Materiaux.
REALIZATION OF EQUIPMENT FOR MANUFACTURING TITANIUM ALLOY ELECTRODES FOR FIRST STEP MELTING [REALISATION D'EQUIPEMENTS DESTINES A LA CONFECTION D'ELECTRODES DE PREMIERE FUSION EN ALLIAGE DE TITANE]
F. Pautonnier, P. Thevenin, and A. Vassel Jan. 1990 19 p In FRENCH
(Contract DRET-88-34-001)
(ONERA-RT-15/3578-M; ETN-90-97564) Avail: NTIS HC A03/MF A01

Investigations of new titanium alloys require consumable electrodes fabricated by double melting under vacuum. The equipment needed to obtain the electrodes applied in the first melting step is described. In the proposed technique, pellets of titanium and alloys are cold-compacted into cylindrically shaped structures which are welded together. The equipment and the technique can obtain 3 to 6 kg of high quality titanium alloys. ESA

N90-29499# National Aerospace Lab., Tokyo (Japan).
EVALUATION OF STATIC AND FATIGUE PROPERTIES OF THIN SHEETS OF 8090-T8 ALUMINUM-LITHIUM ALLOY AND OBSERVATION OF ITS FRACTURE SURFACES
Toshiyuki Shimokawa, Yoshiaki Kakuta, and Yasumasa Hamaguchi Nov. 1989 16 p In JAPANESE; ENGLISH summary
(NAL-TR-1039; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy, which was developed for aircraft structures are evaluated. Systematical tests of this material and conventional 2024-T4 and 7075-T6 aluminum alloys were conducted. Static tests provided data on mechanical properties such as tensile strength, yield strength, elongation, and Young's modulus. Hardness tests gave data on Vickers hardness. Fatigue tests yielded data on S-N relationships of circular hole notched specimens, crack growth behavior, and fatigue crack growth rates as a function of stress intensity factor range. The fracture surfaces formed by static and fatigue tests were observed by a SEM. The obtained results are analyzed and compared with each other. The various distinctive properties of this material are clarified in comparison with those of the conventional aluminum alloys. Author

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N90-29500# Dayton Univ., OH.
EFFECT OF ENVIRONMENT UPON MECHANICAL BEHAVIOR OF STRUCTURAL CERAMICS FOR APPLICATION IN THE DOE CERAMIC TECHNOLOGY FOR ADVANCED HEAT ENGINES PROJECT Final Report, Jan. 1985 - Dec. 1986
N. L. Hecht, G. A. Graves, D. E. McCullum, A. P. Berens, S. Goodrich, J. D. Wolf, J. R. Hoenigman, P. Yaney, D. Grant, and S. Hilton et al Jun. 1990 165 p Prepared for Oak Ridge National Lab, TN
(Contract DE-AC05-84OR-21400)
(DE90-014770; ORNL/Sub-84-00221/1) Avail: NTIS HC A08/MF A01

The primary goal of this research was to determine the effect of environment upon toughening and strength in commercially available transformation-toughened ceramics (partially stabilized ZrO2 (PSZ) and dispersion toughened Al2, O3 (DTA)). Emphasis was on understanding the mechanism(s) responsible for environmentally induced strength degradation in the temperature range of 25 to 1050 C. Dynamic fatigue techniques (four-point flexural strength as a function of stressing rate) were used in a three-phase plan to investigate fracture strength and slow crack growth in environments containing controlled amounts of water vapor. Similar measurements were also conducted in inert atmospheres (dry N2) to distinguish intrinsic effects from environmentally derived effects. In addition, the effects of aging (extended exposure at elevated temperatures and selected atmosphere conditions) on the candidate materials at low temperatures were studied. The activities pursued and the results obtained are described in this report. DOE

N90-29501# Atomic Energy of Canada Ltd., Chalk River (Ontario). Fuel Materials Branch.
NON-DESTRUCTIVE EVALUATION OF INFILTRATION-TOUGHENED CERAMICS
J. D. Sullivan, J. H. Root, B. D. Sawicka, and S. J. Glass (Pennsylvania State Univ., University Park.) Nov. 1988 33 p
(DE90-629716; AECL-9728) Avail: NTIS (US Sales Only) HC A03/MF A01

A set of zirconia pellets was subjected to surface toughening by the inclusion of alumina particles into the zirconia matrix before firing. The alumina particles were formed in the matrix by an infiltration process. Nondestructive tests were carried out to measure the density profile, the alumina distribution and the residual strains in the matrix. The density profile was measured by computer tomography, the inclusion distribution and residual strains by neutron diffraction. Residual strains, found in the cores of both infiltrated and control pellets, were attributed to the initial single ended axial pressing of the zirconia powder that formed the matrix. DOE

N90-29502# Texas Univ., Austin. Dept. of Chemical Engineering.
TOUGHENING OF SAN COPOLYMERS BY AN SAN EMULSION GRAFTED RUBBER
Hyungsu Kim, H. Keskkula, and D. R. Paul May 1990 9 p Repr. from Polymer, v. 31, May 1990
(Contract DAAL03-88-K-0004)
(AD-A224213; ARO-25229.21-CH) Avail: NTIS HC A02/MF A01 CSCL 07/6

A series of styrene/acrylonitrile (SAN) copolymers were blended with an SAN grafted butadiene rubber to form ABS type materials. The major focus was the effects of composition of the SAN matrix copolymer, for a fixed SAN graft, on blend toughness, deformation behavior and morphology. The AN content varied from 0 to 40 percent in the matrix copolymers, while the AN content of the emulsion-made graft was fixed at 22.5 percent. Maximum strength and toughness were observed for compositions based on SAN

matrices containing 34 percent AN. Mechanical dilatometry revealed no major changes in deformation mechanism as the AN content of the matrix changed. Most of the deformation was due to dilatational processes, presumably crazing. Transmission electron photomicrographs, on the other hand, showed differences in rubber particle dispersion. The morphology revealed by scanning electron microscopy of fracture surfaces distinguished the ductile and less ductile blends. Issues relating to the miscibility of the component polymers and adhesion are discussed. GRA

N90-29503# Georgia Inst. of Tech., Atlanta. School of Chemical Engineering.
PRECURSOR STRUCTURE-FIBER PROPERTY RELATIONSHIPS IN POLYACRYLONITRILE-BASED CARBON FIBERS Final Report, 1 Jun. 1985 - 15 Jun. 1990
A. S. Abhiraman 12 Jul. 1990 82 p
(Contract N00014-85-K-0636)
(AD-A224246) Avail: NTIS HC A05/MF A01 CSCL 11/2

Carbon fibers occupy a premier position among high performance fiber structures, with a combination of physical and mechanical properties, in tension and in compression, that makes them uniquely suitable for application in many advanced fiber-reinforced composites. Fundamental investigations pertaining to precursor fibers and conversion processes in the last decade have paved the way for significant improvements in mechanical properties, especially in the tensile properties of polyacrylonitrile-(PAN) based fibers. Much of the empiricism which existed in the early phases of carbon fiber development has been replaced by fundamental knowledge of the evolution of structure and properties. Georgia Tech has been a significant contributor to this global effort, with important contributions and current research spanning the range from acrylic precursor fiber formation, through oxidative stabilization, to carbonization. The primary objectives of the research reported here have been to strengthen the fundamental knowledge base and to provide rational directions for advances in precursor fiber structures and process routes to generate new morphologies and superior mechanical properties in PAN-based carbon fibers. Significant progress in this direction has been made through a general emphasis on exploration of the fundamental aspects of the chemical and morphological evolution from PAN-based precursors to carbon fibers. GRA

N90-29504# Army Belvoir Research and Development Center, Fort Belvoir, VA. Materials, Fuels, and Lubricants Directorate.
COMPATIBILITY OF ELASTOMERIC SEAL COMPOUNDS WITH MIL-H-6083 AND MIL-H-46170 HYDRAULIC FLUID Final Report, Dec. 1988 - Jan. 1990
Paul E. Gatza Jun. 1990 33 p
(AD-A224248; BRDEC-2496) Avail: NTIS HC A03/MF A01 CSCL 11/1

The relative deteriorative effects of typical suppliers' lots of MIL-H-6083 and MIL-H-46170 hydraulic fluids are compared on off-the-shelf elastomeric seal and O-ring compounds. Comparisons are also made with results obtained using NBR-L, a reference material cited in AMS 3217. GRA

N90-29505# California Inst. of Tech., Pasadena. Seismological Lab.
DYNAMIC CONSOLIDATION OF SUPER HARD MATERIALS Technical Report, 1 Oct. 1988 - 31 Dec. 1989
Wenbo Yang, G. M. Bond, Hua Tan, Thomas J. Ahrens, and G. Liu (New Mexico Inst. of Mining and Technology, Socorro.) 25 Jun. 1990 57 p
(Contract DAAL03-88-K-0199)
(AD-A224460; ARO-26171.3-MS-A) Avail: NTIS HC A04/MF A01 CSCL 07/4

Shock consolidation experiments were conducted via flyer impact on synthetic diamond (6 to 12 microns) and cubic boron nitride (c-BN) (4 to 8 microns) admixed with SiC whisker, Si3N4 whisker, SiC powder and Si powder contained in stainless steel capsules in the shock pressure range 10 to 30 GPa. Scanning electron microscopy and transmission electron microscopy imaging of the samples revealed no plastic deformation or melting of diamond and virtually no deformation of c-BN, whereas the SiC and Si3N4 whiskers were extensively melted and recrystallized into bundle-shaped crystallites. In contrast, SiC powder mixed with diamond was also melted but demonstrated equant grain growth. A new mixture model of powder plus whisker materials is formulated on the basis of sphere-rod mixing and packing experiments. The model assigns excess porosity to the zone around whiskers and yields a better description of the energy deposition mechanism of the consolidation of powder-whisker systems. Some of the experiments employed Sawaoka's post-shock annealing technique, in which the sample is sandwiched between two layers of a mixture of titanium powder plus carbon. Very well consolidated samples were obtained with post-shock heating under shock pressures of only about 12 GPa. GRA

N90-29506# Wisconsin Univ., Madison. Coll. of Engineering.
EXTENSION OF PLASMA SOURCE ION IMPLANTATION TO ION BEAM ENHANCED DEPOSITION Final Report, 1 Feb. - 31 Jul. 1989
John R. Conrad 5 Oct. 1989 10 p
(Contract DAAL03-89-K-0048)
(AD-A224462; ARO-26401.4-MS) Avail: NTIS HC A02/MF A01 CSCL 11/3

The specific plans consist of the following activities: optimize conditions for elevated temperature PSII-IBED of nitride coatings of Ti, Cr, Nb, V, and Zr on test flats to establish the effectiveness of plasma source ion implantation (PSII) in performing ion beam enhanced deposition; characterize coatings thus developed using test procedures for evaluating the wear, friction, corrosion, and rolling contract fatigue behavior; demonstrate the capability of elevated temperature PSII-IBED on a prototype component, and evaluate its performance; modify and refine our existing Monte Carlo code (TAMIX, developed here) for simulating the elevated-temperature PSII-IBED process and benchmark the code to ensure its predictive capability; and develop a detailed plasma simulation model of PSII to generate realistic ion current and energy distributions of ions to the target (to be used as input to the TAMIX code). GRA

N90-29507# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
SURFACE CHEMISTRY AND STRUCTURAL EFFECTS IN THE STRESS CORROSION OF GLASS AND CERAMIC MATERIALS Final Report, 1 May - 31 Dec. 1989
Carlo G. Pantano and Armando Gonzalez May 1990 23 p
(Contract F49620-88-C-0074; AF Proj. 2303)
(AD-A223305; AFOSR-90-0711TR) Avail: NTIS HC A03/MF A01 CSCL 07/4

The phenomena termed fractoemission was monitored in soda-lime-silica glass specimens during slow crack growth. No electron, ion, or photon signals were detected until crack velocities reached approximately (0.01 meters per second). These observations suggest that the more intense fractoemissions observed during fast fracture are due to dissipation of the excess energy associated with unstable crack growth, but more significantly that fractoemissions are not fundamental to crack propagation in glass. GRA

N90-29508# Naval Research Lab., Washington, DC. Polymeric Materials Branch.
SHEAR-RESISTANT DRAG REDUCTION POLYMERS. PART 1: MOLECULAR INVESTIGATIONS OF POLYMER DRAG REDUCTION AND THE DEVELOPMENT OF LABORATORY SCREENING METHODS Memorandum Report, 1985 - 1988
Oh-Kil Kim and Ling-Siu Choi 14 May 1990 23 p Sponsored by Office of Naval Technology, Arlington, VA
(AD-A223353; NRL-MR-6651-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 07/6

Polyacrylic acid (PAA) is a water-soluble polymer that is well suited for studying molecular influences on polymer drag reduction behavior since its polymer chain conformation and size in water are extremely sensitive to solution conditions. Effects of PAA molecular weight and solution factors such as pH and water quality

were investigated. Solution pH is the most important factor governing conformation of polyelectrolytes such as PAA; a higher pH (leading to size expansion) gives a polymer drag reduction. As is known, molecular weight is an intrinsic factor in polymer drag reduction. Another critical factor for PAA drag reduction is water quality, since mineral ions present in water can induce collapse of the polymer molecules and subsequently, the drag reduction becomes null. However, in mineral-free water (obtained by either demineralization or chemical treatment), PAA drag reduction is remarkable. GRA

N90-29509# Massachusetts Univ., Amherst. Dept. of Chemistry.
THEORETICAL INVESTIGATIONS AND ATTEMPTED SYNTHESIS OF ORGANIC MAGNETIC POLYMERS AND OLIGOMERS Annual Report, 1 Nov. 1988 - 1 Oct. 1989
Paul M. Lahti 6 Mar. 1990 21 p Presented at the ONR Contractors Meeting, 1989 Sponsored by NSF; AFOSR; Petroleum Research Fund; Research Corp. of New England; and Exxon Education Foundation
(Contract N00014-87-K-0464)
(AD-A223409; TR-10) Avail: NTIS HC A03/MF A01 CSCL 07/3

Progress in theoretical and synthetic investigations of organic magnetic species is outlined. Overall, progress was made in synthesis of appropriate groups to allow photochemical and thermal generation of phenoxyl radicals in the solid phase. Thermal stability of a variety of substituted phenoxyl systems generated by these methods in PPMA matrices was investigated. GRA

N90-29510# Massachusetts Univ., Amherst. Dept. of Chemistry.
PROGRESS TOWARD SYNTHESIS OF POLYMERIC POLYRADICALS Progress Report No. 18, 1 Jan. - 1 Apr. 1990
Paul M. Lahti and Frank C. Rossitto 3 Apr. 1990 7 p
(Contract N00014-87-K-0464)
(AD-A223414; TR-18) Avail: NTIS HC A02/MF A01 CSCL 07/6

Attempted synthesis of monomers bearing groups to allow generation of phenoxy moieties is described. In general, such monomers have not been readily isolated. It is felt that functionalization of phenolic groups in an existing polymer will be more efficient, as demonstrated by synthesis and irradiation of poly(4-(2,4,6-tri-tert butylphenyloxalyl) styrene). GRA

N90-29511# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
RHEOLOGY OF FILLER RUBBER: SILICA-SILICONE Interim Report
Mirta I. Aranguren, Elsi Mora, and Christopher W. Macosko 25 Jun. 1990 35 p Submitted for publication Sponsored in part by Dow Corning Corp. Midland, MI
(Contract N00014-88-K-0366)
(AD-A223600; TR-6) Avail: NTIS HC A03/MF A01 CSCL 07/6

This work focuses on the relationship between the morphology of filled rubber and its behavior at small and large deformations. Composites made from vinyl terminated polydimethylsiloxane (PDMS) and different fumed silicas were prepared. Filler concentration ranged from 0 to 40 phr (part of silica per hundred parts of PDMS). Small deformation tests were done using oscillatory shear and showed coupling of the filler and crosslinking effects as high crosslinking density while the effects are more or less independent at low crosslinking levels. GRA

N90-29512# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
EFFECT OF PARTICULATE FILLERS ON THE RHEOLOGY OF POLYMER MELTS Interim Report
Mirta I. Aranguren, Elsi Mora, and Christopher W. Macosko 25 Jun. 1990 45 p Submitted for publication Sponsored in part by Dow Corning Corp. Midland, MI
(Contract N00014-88-K-0366)
(AD-A223601; TR-5) Avail: NTIS HC A03/MF A01 CSCL 07/6

This work focuses in the basic understanding of reinforcement and the relationship between the morphology of the material and its rheological behavior. Mixtures of polydimethylsiloxanes and different fumed silicas were tested under oscillatory shear. The silica structure was kept constant by using a single initial product. Only the surface chemistry was changed. All samples showed a strong strain dependence, and the frequency dependence changed dramatically with silica concentration. Agglomeration increases with silica concentration, amount of silanols on the silica surface and polymer molecular weight. All these observations as well as the relaxation of the different materials are explained with a model in which agglomeration takes place through intermediate chains that link the aggregates to one another. However, low molecular weight suspension showed a different behavior. This behavior was related to the absence of entanglements and low probability of bridging chains. GRA

N90-29513# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
MODIFICATION OF POLYSTYRENE/POLYBUTADIENE BLOCK COPOLYMER FILMS BY CHEMICAL REACTION WITH BROMINE AND EFFECT ON GAS PERMEABILITY
J. Csernica, D. H. Rein, R. F. Baddour, and R. E. Cohen 15 Jun. 1990 41 p
(Contract N00014-87-K-0517)
(AD-A223612; TR-10) Avail: NTIS HC A03/MF A01 CSCL 07/6

Permeability coefficients (P) for several gases were measured in heterogeneous polystyrene/polybutadiene (PS/PB) block copolymer films before and after reaction with aqueous bromine. Films reacted to low and very high extents exhibited decreases in P and increases in selectivity compared to the starting material. At intermediate reaction extents, effective permeability coefficients in the reacted materials were higher than those in the unmodified films, resulting in membranes which exhibited both selectivity and permeability enhancement relative to the starting PS/PB system. These effects on permeability are the combined result of physical and chemical changes in the block copolymer films caused by the bromination reaction. GRA

N90-29514# University of Southern California, Los Angeles. Dept. of Chemistry.
PROCESSING OF POLYMERS USING SUPERCRITICAL FLUIDS End of the Year Report
John J. Aklonis and Eric J. Amis 12 Jun. 1990 9 p
(Contract N00014-89-J-3063)
(AD-A223681) Avail: NTIS HC A02/MF A01 CSCL 07/6

In the past, most of the effort expended in the area of supercritical fluids and polymers has been devoted to chromotography and separation. We propose to explore using supercritical fluids as solvents for the preparation of polymers and polymer blends in the form of fibers, polymer sheets and perhaps irregularly shaped polymer solids. It is well known that many of the most interesting new high tech polymers are exceedingly difficult to fabricate. These polymers exhibit such highly desirable properties as electrical conductivity, extremely high strength or remarkable thermal stability to name but a few. In the supercritical regime, one can vary and control the solvent power of fluids over ranges much broader than those accessible in the usual liquid regime. We are attempting to take advantage of the high variability of solvent power of supercritical fluids with respect to processing of homopolymers as well as making polymer blends with unique properties. GRA

N90-29515# Virginia Univ., Charlottesville.
NON-DESTRUCTIVE METHOD FOR ENVIRONMENTAL BREAKDOWN OF GRAPHITE FIBER REINFORCED POLYMER COMPOSITES Final Report, 25 Jun. 1985 - 31 Dec. 1989
S. Ray Taylor, Leland Melvin, Thomas P. Mangiacapre, George L.

Cahen, Jr., and Glenn E. Stoner 31 Dec. 1989 8 p
(Contract DAAG29-85-K-0137)
(AD-A223729) Avail: NTIS HC A02/MF A01 CSCL 07/6

Studies were made to determine if moisture ingress down the fiber/epoxy interface could be detected as an increase in the double layer capacitance c(d1). To do this, individual unsized fibers were electrically contacted to the end of a wire enclosed in a glass pipette support frame. The free end of this fiber was then secured to the end of the pipette with paraffin, and D(d1) measurements were made employing an electrochemical impedance technique. By measuring the exposed area of each fiber tested, the C(sp) could then be calculated. GRA

N90-29516# Argonne National Lab., IL. Tribology Sect.
ION-BEAM-ASSISTED DEPOSITION OF SILVER FILMS ON ZIRCONIA CERAMICS FOR IMPROVED TRIBOLOGICAL BEHAVIOR
A. Erdemir, D. E. Busch, R. A. Erck, G. R. Fenske, and R. Lee 1990 39 p Presented at the Joint STLE-ASME Tribology Conference, Toronto, Ontario, 7-10 Oct. 1990
(Contract W-31-109-eng-38)
(DE90-009706; CONF-901071-3) Avail: NTIS HC A03/MF A01

Silver coatings of 2 microns nominal thickness were deposited on toughened zirconia ceramics by ion-beam-assisted deposition (IBAD). Tribotests were performed with ball-on-disk machines under a load of 5 N, at velocities of 0.1 to 2 m.s(sup minus 1), and in dry and normal air. The sliding friction coefficients of zirconia on itself ranged from 0.3 to 1.2, and the wear rates spanned more than three orders of magnitude, depending on the sliding velocity. In contrast, the wear of IBAD-silver-coated disks was practically unmeasurable, and the wear of zirconia balls was reduced by factors of 5 to 1200 below that of balls slid against uncoated zirconia disks. Large reductions in friction coefficients were also observed for the pairs that included an IBAD-silver film. Scanning-electron microscopy and laser-Raman spectroscopy were used to elucidate the mechanisms of wear of coated and uncoated ceramics. DOE

N90-29517# Argonne National Lab., IL. Materials and Components Technology Div.
ADHESION OF SILVER FILMS TO ION-BOMBARDED ZIRCONIA
R. A. Erck and G. R. Fenske Feb. 1990 13 p Presented at the Joint STLE-ASME Tribology Conference, Toronto, Ontario, 7-10 Oct. 1990
(Contract W-31-109-eng-38)
(DE90-010088; CONF-901071-2) Avail: NTIS HC A03/MF A01

The effects of ion bombardment on thin film adhesion are not well understood for many metal-ceramic systems. Electron-beam-evaporated silver films were deposited on zirconia substrates either directly on the sputter-cleaned substrate or with the use of a bonding interlayer. Film adhesion was measured with a pull-type tester. Argon and argon/oxygen-ion presputtering produced large increases in adhesion strength, the greatest occurring for the oxygen-ion assist. Deposition of a reactive Cr or Ti intermediate layer also produced large adhesion increases, with Cr the most effective. DOE

N90-29518# Argonne National Lab., IL. Materials and Components Technology Div.
ION-BEAM MIXING OF Fe/B LAYERS FOR TRIBOLOGICAL APPLICATIONS
G. R. Fenske, R. Hu, P. M. Baldo, R. A. Erck, A. Erdemir, R. H. Lee, D. E. Busch, F. A. Nichols, and L. E. Rehn 1990 39 p Presented at the Joint STLE-ASME Tribology Conference, Toronto, Ontario, 7-10 Oct. 1990
(Contract W-31-109-eng-38)
(DE90-010091; CONF-901071-1) Avail: NTIS HC A03/MF A01

Ion-beam mixing of iron and boron deposited layers was investigated as a technique to produce improved tribological coatings on steel substrates. Analysis of the kinetics of the ion-mixing process indicated that processing temperatures between 300 and 450 C were required to achieve mixing of iron and boron multilayered coatings. During film deposition, it is critical to avoid deposition processes such as RF sputtering that trap large quantities of inert gases in the growing films and form blisters during subsequent ion mixing at elevated temperatures. Tribological evaluation of annealed and ion-mixed coatings indicated that the major effect of the ion mixing is formation of hard, wear-resistant, polycrystalline Fe2 B and Fe3 B phases at 450 C and amorphous layers at 300 C. Under partially lubricated conditions, the hard phases increase the duration of a low-friction (coefficient of friction less than 0.2) regime by reducing wear, thereby maintaining a low surface roughness. Under boundary-lubrication conditions, reduced wear was observed in tests on ion-mixed samples and was found to be dependent on the humidity in the test environment. DOE

N90-29519# Oak Ridge National Lab., TN.
WEAR OF ADVANCED CERAMICS: AN OVERVIEW
C. S. Yust 1990 6 p Presented at the Japan International Tribology Conference, Nagoya, Japan, 29 Oct. - 1 Nov. 1990
(Contract DE-AC05-84OR-21400)
(DE90-012166; CONF-901009-3) Avail: NTIS HC A02/MF A01

Many new ceramic compositions and microstructures with improved mechanical properties have been recently developed. These advanced ceramics are of great interest as wear-resistant materials. Fundamental studies are in progress in support of such applications on many monolithic ceramics as well as complex microstructures derived from combinations of two or more of them. Fundamental studies often involve short duration. Unlubricated wear tests even though lubrication and long-term durability is a service requirement. Some results of current wear studies of monolithic and composite ceramics are reviewed ad discussed in this paper. DOE

N90-29520# New Mexico Univ., Albuquerque. Center for Micro-Engineered Ceramics.
PROCESSING OF NANOCRYSTALLINE CERAMICS
Muhsin Ciftcioglu and Merrilea J. Mayo (Sandia National Labs., Albuquerque, NM.) 1990 10 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC04-76DP-00789)
(DE90-015700; SAND-90-1639C; CONF-900466-78) Avail: NTIS HC A02/MF A01

Methods of preparing non-agglomerated powders for three systems -- yttria, titania, and yttria-stabilized zirconia -- are reviewed. The non-agglomerated nature of these powders should make it possible to sinter them into dense ceramic bodies with nanocrystalline grain sizes. Experiments with yttria-stabilized zirconia have shown that this is indeed the case, with mean linear intercept grain sizes of 60 nm resulting from original powder particle diameters of 13 nm. This ultrafine-grained zirconia is shown, in turn, to have superplastic forming rates 34 times faster than a 0.3 micron grained commercial zirconia of the same composition. DOE

N90-29521# Sandia National Labs., Albuquerque, NM.
KINETICS AND STRUCTURE OF SILICATE SOL-GELS
Roger A. Assink, C. Jeffrey Brinker, and Bruce D. Kay 1990 5 p Presented at the IUPAC Symposium on Macromolecules, Montreal, Quebec, 8-13 Jul. 1990
(Contract DE-AC04-76DP-00789)
(DE90-015702; SAND-90-0109C; CONF-9007147-1) Avail: NTIS HC A01/MF A01

The structure of a silicate sol-gel derived material depends on the nature of its reaction kinetics. The chemical state of the silicate sol-gel is characterized by both the functional group concentrations and the distribution of the functional groups about a single silicon atom. Si-29 nuclear magnetic resonance (NMR) spectroscopy provides a way to quantitatively determine these concentrations and distributions as a function of time during the reaction. During the early stages of the sol-gel reaction, the distribution of hydrolyzed species enables one to calculate the relative rates of hydrolysis. During the intermediate stages of the reaction, the rate of formation of various condensed species

enables one to determine the reaction rate constants for both water-producing and alcohol-producing condensation. The chemical bonding of sol-gel derived solid materials can be determined by direct polarization NMR combined with magic angle spinning techniques. These capabilities provide a valuable tool for studying the relationships between the reaction conditions, the chemical kinetics and the resulting structure of the sol-gel derived material. DOE

N90-29522# United Technologies Research Center, East Hartford, CT.
INVESTIGATION OF LASER DIAGNOSTICS OF PACVO (PLASMA ASSISTED CHEMICAL VAPOR DEPOSITION) PROCESSES FOR DEPOSITING HARD FACE COATINGS Performance Report, 1 Sep. 1989 - 31 May 1990
Ward C. Roman 1 Jun. 1990 7 p
(Contract DE-FG02-86ER-13560)
(DE90-016209; DOE/ER-13560/T1) Avail: NTIS HC A02/MF A01

The goal of this project is to improve the understanding of the mechanisms which govern the nonequilibrium reactive plasma of the mechanisms which govern the atomistic or molecular deposition of hard face coatings for erosion resistant applications. The goal is to provide a predictive capability that is severely lacking in the present science base of plasma assisted chemical vapor deposition (PACVD) processing for depositing hard face coatings. Advanced laser diagnostics will be used to probe the plasma for improving process control. DOE

N90-29523# Allied-Signal Aerospace Co., Kansas City, MO.
THERMAL ANALYSIS OF BISMALEIMIDE MATRIX RESINS
David A. Spieker Jul. 1990 7 p Presented at the 19th Annual North American Thermal Analysis Society Conference, Boston, MA, 23-26 Sep. 1990
(Contract DE-AC04-76DP-00613)
(DE90-016283; KCP-613-4326; CONF-9009223-2) Avail: NTIS HC A02/MF A01

Commercial bismaleimide (BMI) resins for composite applications have mechanical properties with values between those of high temperature epoxies and fully aromatic polyimides. The former have the disadvantage of poor hot-wet strength and the latter have the disadvantages of being difficult to process and costly. Current commercial BMI formulations offer good properties retention under hot/wet conditions, comparative ease of processing, and moderate cost. We have used thermal analysis extensively to study commercial BMI materials. This paper will survey the results of analyses which were performed to characterize the thermal behavior of cured BMI resins. DOE

N90-29524 Royal Military Coll. of Science, Shrivenham (England).
THE OPTIMUM POLYMER BINDER FOR PRESSABLE HIGH PERFORMANCE EXPLOSIVES: A PRELIMINARY EVALUATION M.S. Thesis
T. C. Burke Nov. 1989 103 p
(ETN-90-97612) Copyright Avail: Royal Military Coll. of Science, Schrivenham, Swindon, Wiltshire SN6 8LA, England

A preliminary study was conducted on the optimum polymer binder for use with pressable high performance explosives. The requirements for such a binder were identified and three candidates polymers were selected and obtained for practical evaluation; KEL-F 3700, KRATON-G 1650 and IMPRANIL DLH. The polymers were, respectively, a thermoplastic chlorofluoropolymer, a thermoplastic elastomer based on styrene and a polyurethane in aqueous dispersion. A simple batch slurry process was used to coat the polymers onto HMX explosive. Polymer Bonded Explosives (PBX) granule particle size distribution and sensitiveness were measured and the polymer coatings were studied using optical microscopy, scanning electron microscopy and energy dispersive spectroscopy. A brief assessment of PBX granule pressing characteristics was performed. Results and opinions are detailed. ESA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N90-29525# Air Force Astronautics Lab., Edwards AFB, CA.
SPECTROSCOPY OF PROPELLANT-RELATED FLAMES Final Report, Jan. 1989 - May 1990
Tim Edwards Jun. 1990 130 p
(AD-A224068; AL-TR-90-033) Avail: NTIS HC A07/MF A01 CSCL 21/2

Progress made in solid propellant flame chemistry studies is summarized. LIF studies were made of OH, CN, NO, and C2. Success was achieved in laboratory flame studies, but was rare in solid propellant applications. Preliminary studies in a hydrazine/methane/nitrogen dioxide diffusion flame yielded emission spectra from OH, NH, CN, CH, and C2. The vibrational temperatures of the NH and CN were consistent with published mechanisms for chemiluminescent excitation. Chemical kinetic studies of high pressure propellant flame yielded inconclusive results because of gaps in the knowledge of the combustion mechanisms of important species such as CN and NO2. GRA

N90-29526# Naval Postgraduate School, Monterey, CA.
AN EXPERIMENTAL INVESTIGATION OF STRAND BURNING METALLIZED SOLID PROPELLANTS M.S. Thesis
Kevin J. Arnold Dec. 1989 73 p
(AD-A224074) Avail: NTIS HC A04/MF A01 CSCL 21/9

Characteristics of the products of combustion of metallized solid propellant strands at pressures between 250 and 750 psi were investigated using holography and light scattering measurements. In addition, scanning electron microscope and light scattering measurements were used to examine quenched residue. A reduced smoke ZrC propellant and three propellants of varying aluminum loading (2, 4.8, and 16 percent) were examined. The objective of the experiments was to determine if any correlation of results from this method of analysis could be made with results from other more complex solid propellant motor measurements, such as plume probe and signature measurements. The results of these efforts reflected the inability of any single technique of analysis to completely describe particle size distributions. These results also suggest the need for modification of current experimental apparatus and procedures. GRA

N90-29527# IIT Research Inst., Bartlesville, OK.
PRODUCTION OF JET FUELS FROM COAL-DERIVED LIQUIDS. VOLUME 13: EVALUATION OF STORAGE AND THERMAL STABILITY OF JET FUELS DERIVED FROM COAL LIQUIDS Interim Report, Aug. 1988 - Dec. 1989
G. P. Sturm, Jr., R. D. Grigsby, J. W. Goetzinger, J. B. Green, and R. P. Anderson May 1990 69 p
(Contracts DE-FC22-83FE-60149; MIPR-FY1455-86-N0657; AF Proj. 2480)
(AD-A224576; AFWAL-TR-87-2042-Vol-13) Avail: NTIS HC A04/MF A01 CSCL 21/4

An investigation of the potential of the production of jet fuel from the liquid by-products streams produced by the gasification of lignite at the Great Plains Gasification Plant (GPGP) in Beulah, North Dakota is discussed. Funding was provided to the Department of Energy, Pittsburgh Energy Technology Center, to administer the experimental portion of this effort. This report details the program with the National Institute for Petroleum and Energy Research of the IIT Research Institute to study the storage and thermal stability of a JP-8 fuel produced from the GPGP liquid by-products streams. Sediments and deposits from stability tests were analyzed by IR and probe microdistillation/high resolution mass spectroscopy. Results were compared with corresponding results from a conventional petroleum-derived JP-8 fuel. GRA

N90-29528# Fraunhofer Inst. fuer Kurzzeitdynamik, Freiburg im Breisgau (Germany, F.R.).
ELECTRICAL IGNITION OF HAN-BASED LIQUID PROPELLANTS Final Report, Oct. 1986 - Dec. 1989
G. Klingenberg, H. J. Frieske, and H. Rockstroh Jan. 1990 76 p
(Contract DAJA45-86-C-0029)
(AD-A223272; R/D-5329-AN-01) Avail: NTIS HC A05/MF A01 CSCL 21/9

The feasibility of arcless ignition in a 2 cu cm igniter element was demonstrated in a vented chamber and in a 30-mm regenerative liquid propellant gun. The igniter shaped vented outer electrode by a hollow cylindrical insulator. Simple steady-state potential field calculations were used to optimize the electrode and cavity geometries. The energy transfer to the igniter is determined mainly by polarity, electrode surface area and charge voltage. Stronger confinement of the liquid propellant igniter charge will accelerate the ignition process. Scanning electron microscopy (SEM) and x-ray microanalysis show that ignition is affected by the chemical and physical characteristics of the electrode surface. Preliminary tests with multi-channel IR-spectrometry for recording the transient ignition reactions were also performed. GRA

N90-29529# EG and G Mound Applied Technologies, Miamisburg, OH.
DEVELOPMENT AND EVALUATION OF HERMETIC LASER DIODE IGNITED PYROTECHNIC COMPONENTS
Daniel P. Kramer, Thomas M. Beckman, and David W. Ewick 1990 11 p Presented at the 15th International Pyrotechnics Seminar, Boulder, CO, 9-13 Jul. 1990
(Contract DE-AC04-88DP-43495)
(DE90-015745; MLM-3649(OP); CONF-900792-12) Avail: NTIS HC A03/MF A01

The present research has focused on developing laser ignited components based on a laser/optical fiber combination in place of bridgewires and pins. This technology uses a laser diode to produce an output through the optical fiber of sufficient energy to function the component. The fabrication of components containing lengths of optical fibers sealed to stainless steel connectors was demonstrated. These components were determined to be hermetic with helium leak rates of less than 1 x 10(exp -9) cu cm/s. The high temperatures required for seal formation did not modify the transmission and beam profile characteristics of the optical fibers. The function characteristics of the fabricated components were evaluated by loading the components and performing firing tests. Components were loaded with either Ti/KClO4 or CP (2-(5-cyanotetrazolato) pentaamine cobalt III perchlorate). Firing tests were performed using AlGaAs laser diode arrays, which emit at a wavelength of approximately 850 nanometers. The diode was coupled to the pyrotechnic component via the optical fiber. DOE

N90-29530# EG and G Mound Applied Technologies, Miamisburg, OH.
ANALYSIS OF PYROTECHNIC DEVICES BY LASER-ILLUMINATED HIGH SPEED PHOTOGRAPHY
Larry R. Dosser and Margaret A. Stark 1990 7 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract DE-AC04-88DP-43495)
(DE90-015741; MLM-3647(OP); CONF-900756-34) Avail: NTIS HC A02/MF A01

Several types of pyrotechnic igniters have been evaluated using the technique of laser-illuminated high speed photography with a copper vapor laser. The accompanying video tape shows the results of high speed films recorded for two types of igniters (Type X1 and Type X2) fired in confinement in a lucite block and four types of igniters (Type X1, Type X2, Type X3, and Type X4) igniters fired at ambient. The films of the Type X1 and Type X2 igniters were recorded for both a coarse particle titanium potassium perchlorate (TiKP) output charge and a fine particle TiKP output charge. The results of these films are most informative, and the technique is shown to be useful as a design tool for studying the performance of igniters. DOE

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology*.

No abstracts in this category.

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N90-29531# Army Construction Engineering Research Lab., Champaign, IL.
AUTOPAVER: A SOFTWARE PACKAGE FOR AUTOMATED PAVEMENT EVALUATION Final Report
Mark D. Ginsberg, M. Y. Shahin, and Jeanette A. Walther Jul. 1990 22 p
(DA Proj. 4A1-62731-AT-41)
(AD-A224176; CERL-TR-M-90/15) Avail: NTIS HC A03/MF A01 CSCL 12/5

This research developed a method that improves data collection and reduces data entry times for Pavement Condition Index (PCI) surveys for use with PAVER, a pavement maintenance management system. The method, AutoPAVER, is a microcomputer software package used to analyze pictures of pavement surfaces and to forward the resulting analysis to PAVER. The user works interactively with the system to identify and classify pavement distresses. Distress measurement and data entry are done on the computer. GRA

N90-29532# Oak Ridge National Lab., TN.
A COST-EFFECTIVE REALIZATION OF ENVIRONMENTAL TEMPERATURE CONTROL
Timothy E. McKnight and Charles A. Mossman 1990 18 p Presented at the International Conference and Exhibition of the Instrument Society of America, New Orleans, LA, 14-19 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011651; CONF-901017-3) Avail: NTIS HC A03/MF A01

Thermal expansion caused by small temperature variations during machining is a limiting factor in the production of high-quality optics. Conventional facilities required for environmental control of machining areas are very expensive and represent significant capital investments for small or medium size companies. This paper describes an economical modularized facility and thermal control system that will maintain temperature stability to within plus minus 0.1 F. This system uses only commercially available instrumentation and heating, ventilating, and air conditioning (HVAC) equipment and provides improved control at much less cost than conventional facilities. DOE

N90-29533# Lawrence Livermore National Lab., CA.
LAPPING: POLISHING AND SHEAR MODE GRINDING
Norman J. Brown Feb. 1990 13 p Presented at the OSA Science of Optical Finishing Workshop, Monterey, CA, 10-12 Jun. 1990 Revised Submitted for publication
(Contract W-7405-eng-48)
(DE90-015188; UCRL-102845-Rev-1; CONF-9006252-1-Rev-1)
Avail: NTIS HC A03/MF A01

It is the thesis of this paper that shear mode grinding (SMG), (ductile grinding, nanogrinding, fractureless grinding) is just a particular form of polishing. It may be unique in that it can involve a hard wheel of very precise dimensions compared to the soft laps usually used in polishing. Such a wheel would permit the fabrication of a precision surface on a brittle material such as

glass at a precisely located and oriented position on a part. The technological and economic consequences of such a process seem important but the technical obstacles to implementing the technique are for the moment formidable. It is in production in Japan. This paper provides a bit of understanding of that process obtained by making an end run around the obstacles to view the process from the vantage point of lapping. The paper will lay out some of the concepts and terminology necessary to understand the papers that have supplied the real labor to get us to this point. It will refer to parts of this work briefly in passing so the readers who need the details know where to look, and for what, in the bibliography appended. DOE

N90-29534# EG and G Mound Applied Technologies, Miamisburg, OH.
AN EFFECTIVE LOW-PROFILE THERMITE TORCH
Jonathan H. Mohler, Danny L. Halcomb, and David R. Begeal (Sandia National Labs., Albuquerque, NM.) 1990 15 p Presented at the 15th International Pyrotechnics Seminar, Boulder, CO, 9-13 Jul. 1990
(Contract DE-AC04-88DP-43495)
(DE90-015746; MLM-3650(OP); CONF-900792-13) Avail: NTIS HC A03/MF A01

A thermite torch was designed and built for use in a space-limited environment. The intended application required that a series of these torches be ignited from a single, external pyrotechnic source. Novel design features and optimized use of a single thermite formulation made it possible to achieve the required performance, within the constraints of the application system. DOE

N90-29535 Physics and Electronics Lab. TNO, The Hague (Netherlands).
INVESTIGATION METHOD FOR AA-PROXIMITY FUSES Final Report
O. J. Bloem Jul. 1989 72 p In DUTCH; ENGLISH summary
(Contract A86/KM/110)
(FEL-89-A194; TD-89-3566; ETN-90-97412) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, The Netherlands

A method of investigation into the operation of radio CW-Doppler proximity fuses is described. The method is to be used particularly to investigate the sensing function of proximity fuses intended for antiaircraft purposes in a naval environment. Using simulation and measuring systems, air target and sea surface reflections can be recorded. A software model makes it possible to realize a low frequency processing for the sensing function, resulting in a desired burst behavior and an effective sea clutter suppression. Measurements on prototypes and in the laboratory as well as during firing tests can be performed using the two test facilities. ESA

N90-29536 Physics and Electronics Lab. TNO, The Hague (Netherlands).
SONA: A MEASUREMENT SYSTEM FOR THE DETERMINATION OF THE END-OF-FLIGHT BURST BEHAVIOUR OF PROJECTILES EQUIPPED WITH PROXIMITY FUSES Final Report
A. I. Bol Nov. 1989 41 p In DUTCH; ENGLISH summary
(Contract A81/KL/121)
(FEL-89-A293; TD-89-4445; ETN-90-97415) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, The Netherlands

Acceptance tests of the proximity fuse 169 for the Royal Netherlands Army were carried out above a water surface. Due to the relatively long distance, the observation of the end-of-filght burst behavior by the human observer can be difficult, especially under bad weather conditions. An acoustical measuring system, SONA, was investigated and applied to overcome this problem. The performance of the system was compared with that of the usual photographic technique. The system can be used for the acceptance tests of other types of fuses if the end speed of the projectile is sufficiently lower than the sound speed. ESA

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N90-29537# National Defence Research Establishment, Stockholm (Sweden). Dept. of Information Technology.
[ACTIVITIES OF THE DIVISION OF MICROWAVE TECHNOLOGY] Annual Report, 1988-1989
Birgitta Lewerentz, ed. Nov. 1989 42 p In SWEDISH; ENGLISH summary
(FOA-C-30555-3.2; ISSN-0347-3708; ETN-90-97106) Avail: NTIS HC A03/MF A01; National Defence Research Establishment, P.O. Box 1165, S-581 11 Linkoeping, 50 Swedish crowns

Multistatic radar technology requirements are very high for antennas, where a maximum of flexibility is desired. Multilobes are often used, or groups of antennas which are electrically operated. Electronics and other electrical equipment were studied for supporting ionizing radiation and several forms of electromagnetic radiation. Ferrite components were studied. For microwave and optical technology, applications are reported. High effect Pulse Microwave radiation (HPM) emitting from an antenna and creating trouble in the electronic equipment, or destruction of this equipment is discussed. The defense against HPM is studied. ESA

N90-29538# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
TWO-DIMENSIONAL SIGNAL PROCESSING AND STORAGE AND THEORY AND APPLICATIONS OF ELECTROMAGNETIC MEASUREMENTS Final Report, 15 Apr. 1987 - 14 Apr. 1990
R. W. Schafer and D. T. Paris 15 Jul. 1990 22 p
(Contract DAAL03-87-K-0059)
(AD-A224239; ARO-24820.8-EL) Avail: NTIS HC A03/MF A01 CSCL 14/3

Specific topics covered are as follows: digital signal processing, parallel processing architectures, 2-D optical storage and processing, hybrid optical/digital signal processing, electromagnetic measurements in the time domain, and automatic radiation measurements for near field and far field transformations. GRA

N90-29539# Arizona State Univ., Tempe.
MODELING AND RECONSTRUCTION ALGORITHMS FOR DETECTION, LOCATION, AND IDENTIFICATION OF SUBSURFACE ANOMALIES Final Report, 15 Apr. 1985 - 14 Apr. 1990
Constantine A. Balanis and Mark Frank 1 Jun. 1990 293 p
(Contract DAAG29-85-K-0045)
(AD-A224358; ARO-21470.11-GS) Avail: NTIS HC A13/MF A02 CSCL 17/11

Techniques for modeling and reconstructing images of subsurface anomalies, in a hole-to-hole system configuration, have been investigated. The region under examination is scanned by transmitting electromagnetic rays through the region. Numerical algorithms have been developed for solving the reconstruction problem. The singular value decomposition method has played a key role in fulfilling this goal. In particular, the conjugate gradient algorithms is used with the gradient projection method to obtain a highly stable and efficient technique which is able to incorporate inequality constraints. These inequality constraints represent one type of priori information that can be used to yield better solution to detect, locate, and identify subsurface anomalies. The method of weighted least squares is used to include a priori information into the solution. Two ways of explicity adding this information into the reconstruction process are given, and their effectiveness to reducing additive noise is demonstrated. To obtain images of subsurface anomalies which are the most representative of the actual cross sections being investigated, both continuous wave and time-of-flight measurements are utilized. GRA

N90-29540# Missouri Univ., Columbia. Dept. of Physics.
MICROSCOPIC MODELS FOR ELECTROMAGNETIC WAVE PROPAGATION IN HIGHLY DISPERSIVE MEDIA Final Report, 1 May 1989 - 30 Apr. 1990
Brian DeFacio 18 Jun. 1990 12 p
(Grant AF-AFOSR-0311-89; AF Proj. 6177)
(AD-A224382; AFOSR-90-0772TR) Avail: NTIS HC A03/MF A01 CSCL 20/15

The purpose of this project was to advance the understanding of the propagation of ultrafast picosecond electromagnetic pulses in biological solutions and ultimately, in human tissue. Present day standards of the allowed electromagnetic doses do not include dispersion, modulation or envelope effects, memory or nonlinearity. It is well-known experimentally that biological solutions are highly dispersive. It is plausible, but not established, that modulation, memory, and nonlinearity may be important in biological solutions. Hence, this project represents a first step toward better standards. GRA

N90-29541# Army Test and Evaluation Command, Aberdeen Proving Ground, MD.
RADAR RECEIVER PROCEDURES Final Report
6 Apr. 1990 85 p
(AD-A224399; ITOP-6-2-529) Avail: NTIS HC A05/MF A01 CSCL 17/9

This International Test Operations Procedures (ITOP) outlines the test methods used in evaluating the performance and characteristics of general types of radar receivers to include single or variable frequency receivers. The test methods serve as a guide in determining the overall efficiency of such equipment as a function of their design and their recorded performance. If a conflict exists between the accuracies, frequency, and levels stated in this ITOP and those stated in the appropriate requirements documents, the requirements documents must be used. GRA

N90-29542# Spectral Sciences, Inc., Burlington, MA.
THERMAL IMAGING ASSESSMENT Interim Report No. 2, 15 Jan. 1990 - 15 Feb. 1990
S. C. Richtsmeier and M. E. Gersh 22 Feb. 1990 25 p
(Contract F19682-88-C-0074)
(AD-A224400; SSI-TR-171; GL-TR-90-0044; SR-2) Avail: NTIS HC A03/MF A01 CSCL 17/5

This report investigates the feasibility of using advanced focal plane arrays coupled with telescopes as thermal imaging systems for orbiting targets. The infrared signature of a target will depend on a host of intercoupled factors including (1) surface properties (temperature, emissivity, reflectivity), (2) illumination conditions (solar position, earth background temperature), (3) target orientation, location, and dynamics with respect to the observer, and (4) atmospheric conditions along the illumination and target-observer paths. The determination of absolute surface temperatures of an unknown target is certainly a difficult if not infeasible problem without detailed knowledge of all of these factors. Here, the somewhat simpler problem is addressed to calculate the change in detected signal observed as a function of relative surface temperature differences, or conversely, given a sensor and its inherent characteristics, we attempt to determine the minimum detectable temperature difference measurable for a target surface of known characteristics. GRA

N90-29543# Systems Exploration, Inc., San Diego, CA.
SOUNDER UPDATE AND FIELD STRENGTH SOFTWARE MODIFICATIONS FOR SPECIAL OPERATIONS RADIO FREQUENCY MANAGEMENT SYSTEM (SORFMS). VOLUME 1: PROGRAM DESCRIPTIONS AND TESTING Final Report
Jun. 1990 112 p
(Contract N66001-86-D-0079)
(AD-A224510; NOSC/TD-1848-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 12/5

The purpose of this document is to provide information about the Special Operations Radio Frequency Management System (SORFMS) model enhancements produced by Systems Exploration, Inc. The enhancements include the incorporation of a Sounder Update (SU) model and an improved version of the Field Strength (FS) model. The SU model is an adaptation and translation to FORTRAN of the Army PROPHET Evaluation System (APES) BASIC model. The FS enhancements involve modification of the field strength modeling algorithms, consequential to efforts to improve the accuracy of this model. The SORFMS is a small, lightweight, stand alone and highly transportable real time propagation assessment and forecasting system which defines natural propagation constraints on HF transmissions and outputs this data in an easily interpreted format. The system includes an HF transmitter, HF receiver, spectrum monitor, frequency management terminal, and a portable computer. The system software, described herein, is installed on the portable computer. GRA

N90-29544# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
THE f2 DOMINANCE OF THE ENERGY-MOMENTUM TENSOR
Hidezumi Terazawa Feb. 1990 8 p
(DE90-508027; INS-809) Avail: NTIS (US Sales Only) HC A02/MF A01

By assuming f(sub 2) dominance of the energy-momentum tensor and by using the Ward identity for the vertex function of the trace of the energy-momentum tensor and the two electromagnetic currents, the partial decay width of f(sub 2) yields gamma gamma is estimated to be 1.9 + or - 0.2 keV, which is in a good agreement with the latest experimental data of 2.27 + or - 0.47 (stat.) + or - 0.11 (syst.) keV by the TOPAZ Collaboration in TRISTAN. DOE

N90-29545# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ANALYSIS AND DESIGN OF MODIFICATIONS FOR IMPROVED PERFORMANCE OF THE AFIT RADAR CROSS SECTION MEASUREMENT CHAMBER M.S. Thesis
Anthony J. Hunt Jun. 1990 133 p
(AD-A223352; AFIT/GE/ENG/90J-03) Avail: NTIS HC A07/MF A01 CSCL 17/9

Improvements and characterization of the AFIT Radar Cross Section (RCS) measurement chamber are studied. The two main areas of improvement included the support pedestal and antennas. Characterization included antenna and system performance as pertains to aliasing, noise floor and quiet zone definition. Support pedestal improvement involved consideration of the three primary types used; the suspension line support, foamed plastic columns, and ogive-shaped metal pylon. Antenna improvement included installing broad bandwidth, low side-lobe antennas. These were mounted so that they could be easily rotated for polarization selection, and so that they provided a good approximation to a backscatter angle of zero degrees without incurring high antenna coupling. System aliasing measurements and analysis was performed to ensure that the full bandwidth capacity of the antennas was achievable without causing alias error signals to enter the target zone. Noise floor data was taken to determine the degree of sensitivity improvement after modifications. Quiet zone characterization was designed to verify predictions and provide actual dimensions for measurement analysis. Additionally, the quiet zone measurements provided information as to the pedestal location relative to the focus of the antenna. GRA

N90-29546# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
BISTATIC RADAR CROSS SECTION OF A PERFECTLY CONDUCTING RHOMBUS-SHAPED FLAT PLATE
Alan J. Fenn 2 May 1990 83 p
(Contract F19628-90-C-0002)
(AD-A223418; TR-880; ESD-TR-90-008) Avail: NTIS HC A05/MF A01 CSCL 17/9

The bistatic radar cross section of a perfectly conducting flat plate that has a rhombus shape (equilateral parallelogram) is investigated. The Ohio State University electromagnetic surface patch code (ESP version 4) is used to compute the theoretical bistatic radar cross section of a 35- x 27-in rhombus plate at 1.3

GHz over the bistatic angles 15 deg to 142 deg. The ESP-4 computer code is a method of moments FORTRAN-77 program which can analyze general configurations of plates and wires. This code has been installed and modified at Lincoln Laboratory on a SUN 3 computer network. Details of the code modifications are described. Comparisons of the method of moments simulations and measurements of the rhombus plate are made. It is shown that the ESP-4 computer code provides a high degree of accuracy in the calculation of copolarized and cross-polarized bistatic radar cross section patterns. GRA

N90-29547# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
JAMMING PERFORMANCE OF FREQUENCY-HOPPED COMMUNICATION SYSTEMS WITH NONUNIFORM HOPPING DISTRIBUTIONS
Patrick R. Hirschler-Marchand 25 Apr. 1990 55 p
(Contract F19628-90-C-0002)
(AD-A223419; TR-878; ESD-TR-89-298) Avail: NTIS HC A04/MF A01 CSCL 17/4

This report presents an analysis of the jamming performance of frequency-hopped communication systems in which the user-signal hops according to a nonuniform distribution across the available hopping bandwidth. GRA

N90-29548# Naval Postgraduate School, Monterey, CA.
AN EXPERIMENTAL STUDY OF VOICE COMMUNICATION OVER A BANDLIMITED CHANNEL USING VARIABLE BIT WIDTH DELTA MODULATION M.S. Thesis
N. Nur Tumok Dec. 1989 45 p
(AD-A223445) Avail: NTIS HC A03/MF A01 CSCL 25/4

A variable bit width delta modulator (VBWDM) demodulator was designed, built and tested to achieve voice and music communication using a bandlimited channel. Only baseband modulation is applied to the input signal. Since there is no clock used during the digitizing process at the modulator, no bit synchronization is required for signal recovery in the receiver. The modulator is a hybrid design using 7 linear and 3 digital integrated circuits (IC), and the demodulator uses 2 linear ICs. A lowpass filter (LPF) is used to simulate the channel. The average number of bits sent over the channel is measured with a frequency counter at the output of the modulator. The minimum bandwidth required for the LPF is determined according to the intelligibility of the recovered message. Measurements indicate an average bit rate required for intelligible voice transmission is in the range of 2 to 4 kilobits per seconds (kbps) and between 2 to 5 kbps for music. The channel 3 dB bandwidth required is determined to be 1.5 kilohertzs. Besides the hardware simplicity, VBWDM provides an option for intelligible digitized voice transmission at very low bit rates without requiring synchronization. Another important feature of the modulator design is that no bits are sent when no signal is present at the input which saves transmitter power (important for mobile stations) and reduces probability of intercept and jamming in military applications. GRA

N90-29549# Electronics Research Lab., Adelaide (Australia). Communications Div.
CONTROL OF A COSSOR CSP1250 IONOSPHERIC SIMULATOR IN AN AUTOMATED HF TEST BED
Patricia L. Slingsby May 1990 57 p
(AD-A223446; ERL-0511-RE; DODA-AR-006-401) Avail: NTIS HC A04/MF A01 CSCL 20/14

The development of modems, scramblers, or hopping units for HF channel operation requires repeatable and comparative tests to be carried out under typical conditions. By using HF channel ionospheric simulators these tests can be carried out more cost-effectively and conveniently without the need for the relatively expensive live-link tests which would otherwise be necessary. Such simulators not only provide repeatable HF channel conditions, they also permit some control of the link parameters - an aspect not readily achievable with live circuits. The Automated high frequency Test Bed currently under development at the Electronics Research Laboratory (ERL) uses a Cossor CSP1250 Ionospheric Simulator. The Test Bed also incorporates transmit and receiver modems, data error analysers (which generate and monitor a pseudo-random bit sequence, and a Pilot Tone Sounder (which performs bit-error-rate analysis of the received data). A functional diagram of the ERL Automated Test Bed is provided. GRA

N90-29550# Electronics Research Lab., Adelaide (Australia).
HIGH RANGE RESOLUTION RADAR CROSS-SECTION PROFILES: A PRELIMINARY ANALYSIS
Stephen D. Elton Jan. 1990 18 p
(AD-A223448; ERL-0502-RN; DODA-AR-005-982) Avail: NTIS HC A03/MF A01 CSCL 17/9

The following provides a brief and informal account of an analysis technique used by the Electronic Warfare Division (EWD) to produce high range resolution radar cross-section (RCS) profiles of maritime targets. A simple theoretical discussion is given for the basic principle behind the technique employed, and then the computer program used to carry out the first stage of the RCS analysis is described and compared with other work. High range resolution RCS profiles, were derived for a maritime target with the use of a coherent radar system developed by the Microwave Radar Division (MRD). Synthetic range profiles were obtained for the ship by exploiting the reciprocal relationship that exists, in the context of the present work, between range and frequency and by employing a fast Fourier transform (FFT) algorithm to evaluate the inverse discrete Fourier transform (IDFT). The technique is referred to in the literature as stepped frequency imaging. GRA

N90-29551# Naval Ocean Systems Center, San Diego, CA. Tropospheric Branch.
SPECIFICATION FOR A STANDARD ELECTROMAGNETIC PROPAGATION MODEL Final Report, Jan. 1989 - Jan. 1990
C. P. Hattan Jun. 1990 64 p Sponsored by Naval Oceanographic Office, Bay Saint Louis, MS
(AD-A223556; NOSC/TD-1772) Avail: NTIS HC A04/MF A01 CSCL 20/14

A standard electromagnetic (EM) propagation model was developed. It provides the user with a method of assessing EM propagation from 100 MHz to 20 GHz in the marine environment for a variety of atmospheric conditions. The software implementation of the model returns the pattern propagation factor it describes when a user supplies the model with the proper environment and EM system inputs. The pattern propagation factor is defined as the ratio of the actual electric field at some point to the field that would exist at that point under free-space propagation conditions. Free-space propagation is the propagation of energy that would occur if an omnidirectional point-radiating source were placed in outer space. The model is described in detail and an ANSI FORTRAN program using the model is provided. The program that implements the model can be either incorporated into an application model that requires EM propagation information or used as a stand-alone program. GRA

N90-29552# Johns Hopkins Univ., Baltimore, MD. Dept. of Biophysics.
IEEE CONFERENCE ON NEURAL INFORMATION PROCESSING SYSTEMS, NATURAL AND SYNTHETIC Final Report, 15 Aug. 1988 - 14 Aug. 1989
Terrence Sejnowski 14 Aug. 1989 51 p Conference held in Denver, CO, 28 Nov. - 1 Dec. 1988
(Grant AF-AFOSR-0287-88; AF Proj. 2305)
(AD-A223611; AFOSR-90-0719TR) Avail: NTIS HC A04/MF A01 CSCL 12/9

The proceedings from this conference are presented. Some areas of discussion are as follows: Speedy Alternatives to Back Propagation; Mean Field Annealing and Neural Networks; Comparison of Two LP Parametric Representations in a Neural Network-Based Speech Recognizer; Neural Net Receivers in Spread-Spectrum Multiple-Access Communication Systems; Modeling a Central Pattern Generator in Software and Hardware: Tritonia in Sea Moss; Storage of Covariance by the Selective Long-Term Potentiation and Depression of Synaptic Strengths in the Hippocampus; Convergence and Pattern-Stabilization in the

Boltzmann Machine; MOS Charge Storage of Adaptive Networks; A Link Between Markov Models and Multilayer Perceptrons; and Programmable Analog Pulse-Firing Neural Networks. GRA

N90-29553# Naval Ocean Systems Center, San Diego, CA. Ionospheric Branch.
RADAR CLUTTER VIA RAY METHODS Final Report
R. A. Pappert May 1990 32 p Sponsored by Office of Naval Technology, Arlington, VA
(AD-A223796; NOSC/TD-1809) Avail: NTIS HC A03/MF A01 CSCL 17/9

In a recent study, radar clutter results calculated via waveguide methods were compared with Tappert's backscatter results generated by using parabolic equation and Monte Carlo methods. For the geometries and environments considered, the waveguide results generally broke down for ranges less than about 8 kilometers. In this study, ray methods, along with results of first order scatter theory, are used to calculate clutter for ranges applicable to direct illumination. The latter includes those close in ranges not accessible via waveguide methods. Ray theory comparisons with Tappert's results and waveguide results are given at 9.6 gigahertzs for the standard atmosphere, and for 14 and 28 meters evaporation ducts. Results apply to wind speeds of 10, 20, 30, and 40 knots at a transmitter altitude of 25 meters. GRA

N90-29554# Mission Research Corp., Santa Barbara, CA.
THE EFFECTS ON ANTENNA-FILTERED SCINTILLATION PARAMETERS OF NON-ZERO ANTENNA POINTING ANGLES Technical Report, 1 Oct. 1987 - 30 Dec. 1988
Scott M. Frasier 1 Jul. 1990 45 p
(Contract DNA001-87-C-0169)
(AD-A223840; MRC-R-1220; DNA-TR-89-262) Avail: NTIS HC A03/MF A01 CSCL 20/6

The antenna-filtered generalized power spectral density function (GPSD) for strong scintillation is derived for the general case of two different Gaussian antennas pointed in arbitrary directions relative to the transmitter-receiver line of sight. From the GPSD the normalized signal decorrelation coefficient and the filtered decorrelation distance and time were obtained. Expressions are also derived for the antenna power loss, the filtered frequency selective bandwidth, and the power impulse response function. The results are completely general with respect to pointing angle and the orientation of the antenna relative to the ionization structure. Finally, the power impulse response function is generalized to obtain the signal correlation as a function of delay at two different antennas. A method of using a complete set of correlation coefficients to generate signal realizations for a collection of antennas is outlined. GRA

N90-29555# Army Test and Evaluation Command, Aberdeen Proving Ground, MD.
AIRBORNE TARGET DETECTION, ACQUISITION, AND TRACKING DEVICES Final Report
30 Apr. 1990 23 p Previously announced as N71-26175
(AD-A223852; TOP-6-3-037) Avail: NTIS HC A03/MF A01 CSCL 17/11

TOP 6-3-037 describes general procedures for technical testing of airborne target detection, acquisition, and tracking devices under conditions typical of those for which they were designed. Procedures include: inspection, installation, technical performance, logistics supportability, reliability, achieved availability, compatibility with other equipment, safety, human factors, and personnel and training requirements. Data requirements and presentation are also described. GRA

N90-29556*# Fermi National Accelerator Lab., Batavia, IL.
MICROWAVE BACKGROUND DISTORTIONS FROM DOMAIN WALLS
Guenter Goetz and Dirk Noetzold (Chicago Univ., IL.) 22 Aug. 1990 22 p
(Grant NAGw-1340)
(NASA-CR-187272; NAS 1.26:187272; FERMILAB-Pub-90/176-A) Avail: NTIS HC A03/MF A01 CSCL 20N

Domain walls arising in a cosmic phase transition after decoupling were recently proposed as seeds for the formation of large scale structure. The distortion induced in the microwave background radiation is calculated in dependence of the wall thickness, surface density, scalar field potential, cosmic redshift and the velocity of the wall. It was found that the maximal redshift distortion for both spherical and planar walls is of the order pi G sigma H(sup -1)(sub 0), where sigma is the surface energy density and H(sup -1)(sub 0) the Hubble parameter. It was also found that, for a wall thickness smaller than the horizon, walls can be treated as infinitely thin, i.e., the redshift distortion is independent of the wall thickness and the specific form of the scalar potential. For planar walls moving with a Lorentz-factor gamma the redshift distortion is enhanced by gamma cubed. Author

N90-29557*# Fermi National Accelerator Lab., Batavia, IL.
CHARACTERISTIC MICROWAVE BACKGROUND DISTORTIONS FROM COLLAPSING DOMAIN WALL BUBBLES
Guenter Goetz and Dirk Noetzold (Chicago Univ., IL.) 25 Jul. 1990 12 p
(Grant NAGw-1340)
(NASA-CR-187270; NAS 1.26:187270; FERMILAB-Pub-90/149-A) Avail: NTIS HC A03/MF A01 CSCL 20N

The magnitude and angular pattern of distortions of the microwave background are analyzed by collapsing spherical domain walls. A characteristic pattern of redshift distortions of red or blue spikes surrounded by blue discs was found. The width and height of a spike is related to the diameter and magnitude of the disc. A measurement of the relations between these quantities thus can serve as an unambiguous indicator for a collapsing spherical domain wall. From the redshift distortion in the blue discs an upper bound was found on the surface energy density of the walls sigma is less than or approximately 8 MeV cubed. Author

N90-29558 Physics and Electronics Lab. TNO, The Hague (Netherlands).
NEURAL NETWORKS AND RADAR SYSTEMS Final Report
H. J. Borgers Aug. 1989 191 p In DUTCH; ENGLISH summary
(FEL-89-B65; TD-89-3568; ETN-90-97407) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, The Netherlands

The possibilities of the use of neural networks in radar systems was studied. The literature on neural networks was summarized. The fundamentals of neural network are described. A number of ways in which neural networks can be used to process radar signals are discussed. A flexible tool for the implementation of these networks in a software simulation environment was developed. Several relevant simulations were performed. From the analysis and the simulation results it can be concluded that the signal processing speed and the ability to train the networks with higher order correlations are the main reasons to proceed with this research program. ESA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N90-29559# Atomic Energy of Canada Ltd., Pinawa (Manitoba). Nuclear Research Establishment.
THE NUCLEAR BATTERY
K. S. Kozier and H. E. Rosinger 1988 22 p
(DE90-630400; AECL-9570; ISSN-0067-0367) Avail: NTIS (US Sales Only) HC A03/MF A01

The evolution and present status of an Atomic Energy of Canada Limited program to develop a small, solid-state, passively cooled reactor power supply known as the Nuclear Battery is reviewed.

Key technical features of the Nuclear Battery reactor core include a heat-pipe primary heat transport system, graphite neutron moderator, low-enriched uranium TRISO coated-particle fuel and the use of burnable poisons for long-term reactivity control. An external secondary heat transport system extracts useful heat energy, which may be converted into electricity in an organic Rankine cycle engine or used to produce high-pressure steam. The present reference design is capable of producing about 2400 kW(t) (about 600 kW(e) net) for 15 full-power years. Technical and safety features are described along with recent progress in component hardware development programs and market assessment work. DOE

N90-29560# Naval Postgraduate School, Monterey, CA.
EVALUATION OF A POTENTIAL WAVE DIVISION MULTIPLEXER (WDM) FOR USE IN THE IRSTD M.S. Thesis
Paul Thomas Fernan Dec. 1989 60 p
(AD-A223945) Avail: NTIS HC A04/MF A01 CSCL 09/5

The design of a Wave Division Multiplexer (WDM) was evaluated. This design could be used in the AN/SAR-8 infrared search and target designation system currently being developed by the Navy. The design featured a spherical grating with a radius of curvature of 115mm to test the capability of multiplexing 180 channels. The grating was able to couple light from laser diodes at four different wavelengths (780.0, 789.0, 848.0 and 849.0 nm). The most significant factor in coupling efficiency was astigmatism. This decreased the demultiplexing coupling efficiency by a factor of 500. The source linewidths were measured to assess the possibility of wavelength slicing. The capability to multiplex 180 channels is possible but cannot yet be achieved due to the lack of light sources that cover the wavelength range required for a 180 channel system. GRA

N90-29561# Science Research Corp., Somerville, MA.
DEVELOPMENT OF AN ALL SOLID STATE 6 kHz PULSE GENERATOR FOR DRIVING FREE ELECTRON LASER AMPLIFIERS Final Report, 15 Jul. 1988 - 14 Jul. 1990
Daniel Birx 16 Jul. 1990 191 p
(Contract N00014-88-C-0398)
(AD-A224105; SRL-08-F-1990) Avail: NTIS HC A09/MF A01 CSCL 09/3

Five new, all solid state pulse generators were designed to meet the requirements for an efficient, reliable pulsed power source to drive free electron laser amplifiers. Four of these were constructed and tested. These Silicon Controlled Rectifier (SCR) commutated, nonlinear magnetic pulse compressors will be fully compatible with present high power SDIO induction linac driven free electron laser. By employing SCRs rather than thyratron commutators, these pulsers should provide a significant increase in reliability over the current generation pulsed power drivers proposed as drivers for Free Electron Lasers. SCR-commutated nonlinear magnetic pulse compressors, SNOMAD-I, II, IV and V were successfully tested at SRL. The goals of this research effort were realized. A line of cost effective, reliable, efficient, all solid state induction linac drivers has now been developed. GRA

N90-29562# Illinois Univ., Urbana. Coordinated Science Lab.
VLSI DESIGN FOR RELIABILITY Final Report, Sep. - Nov. 1989
Ibrahim N. Hajj, Farid N. Najm, and Yang Ping May 1990 24 p
(Contract F30602-88-D-0028)
(AD-A224264; RADC-TR-90-93) Avail: NTIS HC A03/MF A01 CSCL 09/1

The results are reported of supplementary work done related to the reliability analysis of Application Specific Very Large Scale Integrated (ASIC VLSI) CMOS circuits. The electromigration susceptibility of VLSI circuits was determined. Electromigration is a major reliability problem caused by the transport of atoms in a metal line due to the electron flow. Under persistent current stress, electromigration can cause deformations of the metal lines which may result in shorts or open circuits. The failure rate due to electromigration depends on the current density in the metal lines and is usually expressed as a median-time-to-failure (MTF). This work focuses on the electromigration problem in the power and ground busses. To estimate the bust MTF, an estimate of the current waveform in each branch of the bus is required. In general, the MTF is dependent on the shape of the current waveform, and not simply on its time-average. However, a very large number of such waveform shapes are possible, depending on what inputs are applied to the circuit. This is especially true for complementary metal oxide semiconductors circuits, which draw current only during switching. GRA

N90-29563# Naval Weapons Center, China Lake, CA.
PROCEEDINGS OF THE 14TH ANNUAL ELECTRONICS MANUFACTURING SEMINAR Annual Report
Feb. 1990 361 p Seminar held at China Lake, CA, 21-22 Feb. 1990
(AD-A224276; AD-E900986; NWC-TP-7066) Avail: NTIS HC A16/MF A02 CSCL 09/1

The proceedings of the seminar are presented. Some aspects of soldering technology and electronics manufacturing are covered. The proceedings are a compilation of information provided to both nongovernment and government sources. Producibility, productivity, and quality are emphasized. GRA

N90-29564# Naval Postgraduate School, Monterey, CA. Dept. of Electrical and Computer Engineering.
CAD MODELS FOR INDUCTIVE STRIPS IN HOMOGENEOUS FINLINE: THE METHODOLOGY Interim Report, 1 Oct. 1989 - 31 Mar. 1990
Jeffrey B. Knorr Mar. 1990 37 p
(AD-A224446; NPS62-90-007) Avail: NTIS HC A03/MF A01 CSCL 09/1

The derivation is presented of a circuit model for homogeneous finline. Several models are described for inductive strips in homogeneous finline. The models are simple, accurate and completely compatible with existing Computer Aided Design (CAD) software. GRA

N90-29565# Rockwell International Corp., Cedar Rapids, IA. Government Avionics Div.
HIGH SPEED BUS TECHNOLOGY DEVELOPMENT Final Report, Sep. 1983 - Aug. 1988
Marlan B. Modrow and Donald W. Hatfield Sep. 1989 175 p
(Contract F33615-83-C-1036; AF Proj. 2734)
(AD-A224486; WRDC-TR-89-1040) Avail: NTIS HC A08/MF A01 CSCL 25/3

The development and demonstration of the High Speed Data Bus system, a 50 Million bits per second (Mbps) local data network intended for avionics applications in advanced military aircraft is described. The Advanced System Avionics (ASA)/PAVE PILLAR program provided the avionics architecture concept and basic requirements. Designs for wire and fiber optic media were produced and hardware demonstrations were performed. An efficient, robust token-passing protocol was developed and partially demonstrated. The requirements specifications, the trade-offs made, and the resulting designs for both a coaxial wire media system and a fiber optics design are examined. Also, the development of a message-oriented media access protocol is described, from requirements definition through analysis, simulation and experimentation. Finally, the testing and demonstrations conducted on the breadboard and brassboard hardware is presented. GRA

N90-29566# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.
PERFORMANCE ANALYSIS OF SUBSPACE-BASED PARAMETER ESTIMATION ALGORITHMS Progress Report, 1 Jan. - 30 Jun. 1990
Richard J. Vaccaro 30 Jun. 1990 5 p
(Contract N00014-90-J-1283)
(AD-A224523) Avail: NTIS HC A01/MF A01 CSCL 09/1

New perturbation formulas were developed for signal and orthogonal subspaces which are estimated from a noisy data matrix. These formulas are: (1) based on a finite amount of data; (2) derived under the assumption of high signal-to-noise ratio; and (3)

applicable to arrays of arbitrary geometry, and they provide a common foundation for all analyses. A number of array processing algorithms were analyzed which are classified as follows: (1) Signal subspace algorithms: ESPRIT, state-space realization (including TAM), and Matrix Pencil; (2) orthogonal subspace algorithms: MUSIC and Min-Norm. Analytical variance formulas were developed for the case in which estimates are obtained by searching for the extrema of a function (used with arbitrary array geometry), as well as the case in which estimates are obtained by rooting a polynomial or finding the eigenvalues of a matrix (used with a uniform line array geometry). In addition, improvements were developed for a state-space algorithm for frequency-wavenumber (2-D) estimation. A procedure to pair individual frequency and wavenumber estimates was given, and it was also shown how a 2-D forward-backward data matrix can be used to improve the performance of the state-space approach. GRA

N90-29567# Arizona State Univ., Tempe. Dept. of Electrical Engineering.
BASIC PROPERTIES AND LIMITS OF INTEGRATED ARRAYS OF DISSIPATIVE CIRCUIT AND LOGIC ELEMENTS Final Technical Report
Robert O. Grondin 1989 30 p
(Contract N00014-85-K-0387)
(AD-A224533; CRR-90030) Avail: NTIS HC A03/MF A01 CSCL 09/1

The efforts are divided into the following categories: (1) the effect of scaling on the performance of integrated device arrays; (2) the development of pipelined content addressable memory; (3) the development of integratable fuzzy neurons; (4) the mapping of graph searches into systolic arrays; and (5) the study of ferroelectric capacitors for application in novel integrated circuits. GRA

N90-29568# Syracuse Univ., NY. Dept. of Electrical and Computer Engineering.
ANALYSIS OF A TM01 CIRCULAR TO TE10 RECTANGULAR WAVEGUIDE MODE CONVERTER Technical Report No. 1, 8 Sep. 1988 - 6 Jun. 1989
Joseph R. Mautz and Roger F. Harrington Aug. 1989 105 p
(Contract DAAL02-88-K-0056)
(AD-A224566; SYRU/DECE/TR-89/3) Avail: NTIS HC A06/MF A01 CSCL 20/3

A TM sub 01 mode is incident in a circular waveguide in which only the TE sub 11 and TM sub 01 modes can propagate. Two apertures in this circular waveguide feed two rectangular waveguides of identical cross section in which only the TE sub 10 dominant mode can propagate. Close each aperture with perfect conductors. Attempting to restore the original tangential electric field on both sides of each of these conductors, the magnetic current M on one side of the conductor and -M on the other side of the conductor. Expand M as a linear combination of expansion functions each of which is approximately the magnetic current associated with one of the rectangular waveguide modes. Substituting this M into the equation of continuity of the tangential magnetic field across the apertures and testing, as in Galerkin's method, this equation with the expansion functions for M, one arrives at a matrix equation which determines the coefficients of the expansion functions in the expansion for M. In turn, M determines the field in the waveguides, and, in particular, the amplitudes of the TE sub 10 modes in the rectangular waveguides. Detailed formulas for the matrix elements are given in terms of Bessel functions and roots of Bessel functions. Further work is required to program these formulas in order to obtain numerical results using a digital computer. GRA

N90-29569 Department of the Navy, Washington, DC.
SYMMETRICAL LAYERED THIN FILM EDGE FIELD-EMITTER-ARRAY AND METHOD FOR ITS PRODUCTION Patent Application
Henry F. Gray, inventor (to Navy) 8 Jun. 1990 17 p
(AD-D014594; US-Patent-Appl-SN-535612) Avail: US Patent and Trademark Office CSCL 09/1

A field emitter array device includes a substrate supporting thin film layers of conductive material and intervening thin film layers of insulative material. The lateral edges of the thin film layers form a field emitter array including a field emitter edge electrode interposed between a pair of control electrodes. The control electrode edges produce a symmetric field causing the flow of field emitted electrons to be substantially parallel to the plane of the control and field emitter edge electrodes. The direction of electron flow can be further controlled by additional electrodes in the form of additional thin film conductive layers or external electrodes. A process for making the emitter device includes forming on a support member a plurality of planar first and second thin film layers of insulative material alternately disposed between first, second and third thin film layers of conductive material, forming a channel through the thickness of the layers of oriented perpendicular thereto, exposing the lateral edges of the layers of conductive and insulative materials adjacent to the channel to form a field emitter edge electrode interposed between a pair of control electrodes. GRA

N90-29570# Texas Univ., Austin. Dept. of Electrical and Computer Engineering.
MICROWAVE ACTIVE FILTERS BASED ON COUPLED NEGATIVE RESISTANCE METHOD
Chi-Yang Chang and Tatsuo Itoh Apr. 1990 106 p
(Contract DAAL03-88-K-0005)
(AD-A223269; ARO-25045.39-EL) Avail: NTIS HC A06/MF A01 CSCL 09/1

Microwave active filters based on the coupled negative resistance method are investigated. The filter tank circuit unloaded Q value is increased to a value close to infinity using this design method. Therefore, filter passband performance improves significantly. A one-pole and a 2-pole narrowband active filter based on end-coupled filter structure are designed and fabricated. Based on the same structure, a one-pole and a 2-pole varactor tunable active filter are also built. A modified end-coupled filter is developed to broaden the bandwidth with a factor from 5 to 20 times. Based on this new structure, three 2-pole active filters with bandwidth from 1.75 percent to 7.5 percent are built. To broaden the filter bandwidth further, a modified parallel-coupled filter structure is introduced. Compared to the traditional parallel-coupled filter, this new structure has better upper stopband performance. The new structure is suitable for broadband active filters with a bandwidth up to 40 percent. All of the active filters described previously are suitable for microwave monolithic integrated circuit (MMIC) due to their planar structures. A one-pole MMIC fixed frequency active filter is designed. GRA

N90-29571# Texas Univ., Arlington. Dept. of Electrical Engineering.
MAGNETOSTATIC WAVE TRANSDUCERS, RESONATORS AND DISPERSION CONTROL Final Report, Oct. 1983 - Jun. 1987
John M. Owens, Ronald L. Carter, W. A. Davis, and Younes Ataiiyan May 1990 157 p
(Contract F19628-84-K-0029)
(AD-A223437; RADC-TR-90-168) Avail: NTIS HC A08/MF A01 CSCL 09/1

The design of magnetostatic surface waves (MSW) and transversal filters is decribed. A variable time delay device is described that uses a cascaded surface wave device and a backward volume wave device. Transducers composed of periodic arrays of shorted microstrip lines are described. Theoretical and experimental work has resulted in the first true synthesized magnetostatic wave transversal filter. Furthermore, sample delay lines showed less than 16 dB insertion loss and 16 Hz bandwidth at 26 40 GHz. GRA

N90-29572# Naval Research Lab., Washington, DC. Fundamental Plasma Processes Branch.
HIGH POWER MICROWAVES FOR DEFENSE AND ACCELERATOR APPLICATIONS Memorandum Report
Wallace M. Manheimer 11 Jun. 1990 74 p Sponsored by

ONR, Arlington, VA
(AD-A223550; NRL-MR-6661) Avail: NTIS HC A04/MF A01 CSCL 09/1

This paper discusses high power microwaves for application to the Defense Department and to the powering of large accelerators. The microwave sources discussed are the Stanford Linear Accelerator klystron, the relativistic klystron, the magnetron and the vircator. GRA

N90-29573# Westinghouse Electric Corp., Baltimore, MD.
RELIABILITY ANALYSIS/ASSESSMENT OF ADVANCED TECHNOLOGIES Final Technical Report, Oct. 1988 - Jul. 1989
W. J. Garry, R. H. Seidl, T. A. Jennings, J. S. Rapa, R. E. Twist, G. E. Dix, S. J. Whelan, M. G. Pecht, A. Dasgupta, and D. M. Aylward et al May 1990 586 p
(Contract F30602-87-C-0186; AF Proj. 2338)
(AD-A223647; RADC-TR-90-72) Avail: NTIS HC A25/MF A04 CSCL 09/1

The technical study was performed to determine the reliability characteristics of advanced technologies. The study covered existing reliability models and the development of new models. The devices that were investigated were: Very Large Integrated Circuits (VLSI), memory circuits, hybrid circuits, microprocessors, and gallium arsenide microwave monolithic integrated circuits (GaAs MMIC). Packaging, environmental quality, and maturity were other factors that were considered in this investigation. The results of the study are: reliability models that extend the range of MIL-HDBK 217, end of life predication models for in-depth circuit and packaging design and new factors quality assessment. These data will be transitioned from the report to MIL-HDBK 217 for use by government and contractor personnel in estimating the reliability of new equipments. GRA

N90-29574# Rome Air Development Center, Griffiss AFB, NY.
RELIABILITY STUDY OF TWT OUTPUT RF WINDOW Report, Feb. - Oct. 1989
Peter J. Rocci May 1990 57 p Original contains color illustrations
(AD-A223688; RADC-TR-90-87) Avail: NTIS HC A04/MF A01 CSCL 09/1

Rome Air Development Center Computer-Aided Systems Engineering Branch (RBES) has documented an in-house effort to evaluate the structural reliability of the output waveguides window on a Traveling Wave Tube (TWT). This window acts as a seal between the TWT's vacuum envelope and output waveguide. Its purpose is to prevent any loss due to leakage of the vacuum while allowing passage of the microwave signal. This particular disk-shaped window is constructed of a ceramic material, beryllia, and contains an inner ring of copper and an outer ring of Monel K-500 (70 to 30 nickle-copper). It was suspected that excessive thermal stresses associated with the very high operating temperatures by this window has caused it to fail. Finite element analyses, along with material failure theories were used to determine the window's response to a time-dependent heat source and operating heat sink temperature. GRA

N90-29575# Durham Univ. (England). School of Engineering and Applied Science.
REPORT ON THE INTERNATIONAL WORKSHOP ON PROGRESS TOWARDS MOLECULAR SCALE ELECTRONICS
28 Mar. 1990 38 p Workshop held in Durham, England, 25-28 Mar. 1990
(Contract DAJA45-90-M-0093)
(AD-A223758; R/D-6332-CH-03) Avail: NTIS HC A03/MF A01 CSCL 20/5

The topics included: (1) the quantum mechanical modelling of electronically active molecules; (2) synthesis of target molecules and polymers; and (3) physical characterization of materials and processes. While the focus was on the design, preparation and properties of molecules displaying electronic activity a number of related topics were covered: (1) electronic processes in biological systems; (2) fabrication of super molecular structures; and (3) appropriate computational schemes. GRA

N90-29576# Crystallume, Menlo Park, CA.
POLYCRYSTALLINE DIAMOND JUNCTION FIELD EFFECT TRANSISTORS (JFETS) Final Report
Maurice I. Landstrass and Dale Moyer 29 Jun. 1990 37 p
(Contract N00014-89-C-0150; NR Proj. S40-5018)
(AD-A223784) Avail: NTIS HC A03/MF A01 CSCL 09/1

The overall objective of this work is to develop a diamond junction field effect transistor (JFET) technology. The JFET transistor design is an approach that takes advantage of diamonds' large bandgap and utilizes this property to help overcome the lack of shallow dopants. The overall approach is to develop a diamond JFET technology through optimization of junction properties that can utilize near degenerate channel boron doping. The high doping levels are necessary to reduce the boron dopant activation energy. The primary approach is to control the built-in junction voltage through nitrogen doping, control junction edge leakage with a passivation technology based on selective oxidation and heavily dope the channel with boron. GRA

N90-29577# Lawrence Livermore National Lab., CA.
HIGH VOLTAGE PICOSECOND PULSE GENERATION USING AVALANCHE DIODES
T. E. McEwan, R. L. Hanks, and J. D. Kilkenny Jul. 1990 7 p Presented at the SPIE's 19th International Symposiim on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract W-7405-eng-48)
(DE90-015194; UCRL-JC-102565; CONF-900756-20) Avail: NTIS HC A02/MF A01

The generation of kilovolt-level sub-100ps wide pulses using the avalanche transit-time effect in abrupt junction P+NN+ silicon diodes is described and the basic theory for this single-shot mode of the microwave TRAPATT oscillator is discussed. We then present a computationally efficient SPICE model and compare simulations to lab data for two basic circuit configurations. DOE

N90-29578# Sandia National Labs., Albuquerque, NM.
LONG PULSE DIODE EXPERIMENTS
Charles R. McClenahan, Gerald J. Weber, Martin W. OMalley, Joseph Stewart, Larry F. Rinehart, and Malcolm T. Buttram 1990 5 p Presented at the 1990 Annual Charged Particle Beam Meeting, San Diego, CA, 11-14 Jun. 1990
(Contract DE-AC04-76DP-00789)
(DE90-016218; SAND-90-1963C; CONF-9006228-2) Avail: NTIS HC A01/MF A01

A diode employing a thermionic cathode has produced 80 A beams at 200 kV for at least 6 microseconds. Moreover, the diode operates at rates as high as 1 Hz. EGUN simulations of the experimental geometry agree with the experiments. Finally, simulation of a proposed diode geometry predicts a 1 kA, 500 kV beam. DOE

N90-29579# Oak Ridge National Lab., TN. Applied Technology Div.
PERFORMANCE TEST PLAN FOR VARIABLE-SPEED ac SUPERCONDUCTING MOTOR
R. A. Hawsey, V. W. Campbell, W. K. Kahl, B. W. McConnell, J. N. Luton, S. W. Schwenterly, C. W. Sohns, and J. M. Bailey (Tennessee Univ., Knoxville.) May 1990 51 p
(Contract DE-AC05-84OR-21400)
(DE90-016208; ORNL/ATD-39) Avail: NTIS HC A04/MF A01

A test plan for evaluation of the performance characteristics of an axial-air-gap, variable-speed ac superconducting motor is presented in this report. A complete description of the electrical and mechanical apparatus and the instrumentation requirements is provided. Static and dynamic testing of the motor will enable comparison of a motor performance as a function of speed, load, and air-gap flux density with an analytical model. DOE

N90-29580# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
THEORETICAL AND EXPERIMENTAL EXAMINATIONS OF BRUSHLESS MONOPHASE DIRECT CURRENT MOTORS Ph.D. Thesis [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN AN BUERSTENLOSEN EINSTRANG-GLEICHSTROMMOTOREN]
Abdel-Karim Daud 1989 157 p In GERMAN Sponsored by Deutsche Akademie Austauschdienst
(ETN-90-97301) Avail: NTIS HC A08/MF A01

The utilization of neodymium boron iron magnets allowed a good calculation of the rotor field because of the strong magnetization. With an artificial superficial charge and artificial field lines, the magnetic field of the excitation magnet system and of the induced winding could be calculated three dimensionally and the winding inductivity could be estimated. The magnetic rotor field was calculated by means of the complex magnetic potential. To obtain the air-gap field, the limit value method was used with the source free magnetic vector potential. It is concluded, that with a minimal technical cost the monophase motor shows a good yield in a extended charge area. ESA

N90-29581# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
UTILIZATION OF A MEASUREMENT PROCESS BY THE EXAMINATION OF UNIVERSAL MOTORS Ph.D. Thesis [ZUR ANWENDUNG EINES MODELLGESTUETZTEN MESSVERFAHRENS BEI DER BEURTEILUNG VON UNIVERSALMOTOREN]
Ekkehard Dreetz 1989 147 p In GERMAN
(ETN-90-97307) Avail: NTIS HC A07/MF A01

The model design, the optimization of the excitation for a safe parameter estimation and the evaluation of the model quality are discussed. A motor description with 8 model parameters was examined for an error diagnosis of defective motors. A parameter estimation is directly obtained from the spectra of the measured signals. A hardware signal processing was not interesting and nonlinearities, differentiation and integration were calculated. The program allows an efficient, flexible and obvious parameter estimation, and can easily be implemented on a personal computer. ESA

N90-29582# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
HIGH FREQUENCY BUNDLE PROTECTION [HOOG FREQUENT BUNDEL BEVEILIGING]
J. D. Schipper 1990 19 p In DUTCH
(DIGEL-1990-1; ETN-90-97533) Avail: NTIS HC A03/MF A01

A high frequency electronics module was designed for protection as well as control purposes. The module consists of four units: the voltage standing wave ratio protection, the Or-gate, the phase shifter controlier/tester, and the attenuator control. The assembly of these units in a single module reduces the sensitivity to pertubations by reducing the number of connectors and by avoiding external connections. The front panel of the module is divided into four parts, each with its own readings and controls. ESA

N90-29583 National Physical Lab., Teddington (England). Div. of Electrical Science.
EVALUATION OF A THERMISTIOR POWER MEASUREMENT SYSTEM FOR USE ON THE NPL ANTENNA EXTRAPOLATION RANGE
D. G. Gentle May 1990 16 p
(NPL-DES-89; ISSN-0143-7305; ETN-90-97616) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

A series of tests designed to evaluate the thermistor power meters for use on the antenna extrapolation range are summarized. These power meters are used to measure the insertion loss as the separation between the antenna is increased. Procedures were written in PASCAL to read the DVM (Drive Voltage Meter) connected to the power meters via the IEEE-488 interface bus. Once these procedures were optimized for speed and accuracy, two thermistor power meters were used to measure the attenuation of a WG 16 rotary vane attenuator. This attenuator was then calibrated against the NPL (National Physics Laboratory) Mark 1 waveguide beyond cutoff attenuator and the performance of the thermistor power meter system was assessed. The uncertainties quoted are at the 95 percent confidence level unless they relate to the accuracy of DVMs, in which case they are 3 sigma values. ESA

N90-29584 Politecnico di Milano (Italy). Dipt. di Elettronica.
A SINGLE WAFER BIT-SLICED CONVOLVER: AN OPTIMUM STATISTICAL SOLUTION FOR THE IMPLEMENTATION OF REDUNDANCY
Sylvie Laserre 1989 14 p
(Rept-89-019; ETN-90-97619) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A statistical study on the way to implement fault tolerance on wafer integrated repetitive systems so as to optimize the fabrication yield is presented. Fault tolerance is introduced at two different levels: wafer and chip level. The optimum amount of redundancy at both levels in terms of area is analytically determined. Taking also into account the existence of the configuration structure, it is shown that it determines completely the optimum solution. ESA

N90-29585 Politecnico di Milano (Italy). Dipt. di Elettronica.
MACRO CELL PLACEMENT WITH NEURAL NET ALGORITHMS
Giancarlo Storti-Gajani 1990 19 p
(Rept-90-020; ETN-90-97622) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milano, Italy

Placement of VLSI (Very Large Scale Integration) macro cells is one of the hard problems encountered in the process of integrated circuits design. Since the problem is essentially NP-complete a solution must be searched for with the aid of heuristics using, maybe, non deterministic strategies. A new algorithm for cell preplacement based on neural nets that may be very well extended to find solution of the final placement problem is presented. Simulations for the part of the algorithm concerning preplacement are carried out on several different examples giving always a sharply decreasing cost function (where cost is evaluated essentially on total length of wires given a rectangular boundary). The direct mapping between neural units and VLSI blocks that is adopted in the algorithm makes the extension to the final placement problem quite simple. Simulation programs are implemented in a interpreted mathematical simulation language and a C language implementation is currently under way. ESA

N90-29867*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
USING MULTIPLE SENSORS FOR PRINTED CIRCUIT BOARD INSERTION
Deepak Sood, Michael C. Repko, and Robert B. Kelley *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 363-372 (For primary document see N90-29830 24-54)
(Grants NAGw-1333; CCA8309/188)
Avail: NTIS HC A19/MF A03 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N90-29586# Naval Underwater Systems Center, New London, CT. Submarine Sonar Dept.
SPECTRAL MEASUREMENTS OF THE WALL SHEAR STRESS AND WALL PRESSURE IN A TURBULENT BOUNDARY LAYER: THEORY Summary Report

William L. Keith 27 Jun. 1990 19 p
(AD-A224070; NUSC-TR-8295) Avail: NTIS HC A03/MF A01 CSCL 14/2

Two derivations are presented which are pertinent to the experimental measurement of turbulent wall shear stress, using flush mounted hot film sensors. The first, a steady state heat transfer analysis, is necessary in order to determine the thickness of the thermal boundary layer that developed over the hot film. The fundamental validity of the use of hot film sensors to measure the wall shear stress depends on the thickness of the thermal boundary layer relative to the thickness of the viscous sublayer in the turbulent boundary layer. The second derivation involves an unsteady heat transfer analysis, which is necessary in order to determine the frequency range over which the fluctuating wall shear stress may be accurately resolved. GRA

N90-29587# Naval Research Lab., Washington, DC. Lab. for Computational Physics and Fluid Dynamics.
NUMERICAL SIMULATIONS OF THE STRUCTURE OF SUPERSONIC SHEAR LAYERS Memorandum Report
B. Farouk (Drexel Univ., Philadelphia, PA.), E. S. Oran, and K. Kailasanath 20 Jul. 1990 42 p Sponsored by ONR, Arlington, VA
(AD-A224164; NRL-MR-6667) Avail: NTIS HC A03/MF A01 CSCL 20/4

Time-dependent two-dimensional numerical calculations were performed to study the mixing characteristics of unforced, planar, confined shear layers formed by two parallel streams of air that come into contact after passing over a splitter plate. The evolution of the shear layer was examined by systematically varying the velocities, densities, and the static pressures of the two streams that come into contact at the trailing edge of the plate. At least one of the streams was always supersonic. For the range of the parameters studied, the supersonic shear layers show some organization, albeit less coherent than their subsonic counterparts. The most amplified frequency, obtained by Fourier analysis of the velocity and pressure fluctuations, depends on the effective inlet momentum thickness. Convective Mach numbers of the streams corresponding to each side of the shear layer were found to be quite different. The simulations indicate that the single convective Mach number as derived from an isentropic model is not sufficient to characterize the mixing behavior when the velocity, pressure, and density ratios are changed independently. GRA

N90-29588# Naval Research Lab., Washington, DC. Lab. for Computational Physics and Fluid Dynamics.
REYNOLDS STRESS AND THE PHYSICS OF TURBULENT MOMENTUM TRANSPORT Final Report
Peter S. Bernard (Maryland Univ., College Park.) and Robert A. Handler 19 Jul. 1990 49 p Sponsored by ONR, Arlington, VA
(AD-A224172; NRL-MR-6685) Avail: NTIS HC A03/MF A01 CSCL 20/4

The nature of the momentum transport processes responsible for the Reynolds shear stress is investigated using several ensembles of fluid particle paths obtained from a direct numerical simulation of turbulent channel flow. It is found that the Reynolds stress can be viewed as arising from two fundamentally different mechanisms. The more significant entails transport in the manner described by Prandtl in which momentum is carried unchanged from one point to another by the random displacement of fluid particles. One point models, such as the gradient law are found to be inherently unsuitable for representing this process. However, a potentially useful non-local approximation to displacement transport, depending on the global distribution of the mean velocity gradient, may be developed as a natural consequence of its definition. A second important transport mechanism involves fluid particles experiencing systematic acceleration and decelerations. Close to the wall this results in a reduction in Reynolds stress due to the slowing of sweep type motions. Further away Reynolds stress is produced in spiraling motions for which particles accelerate or decelerate while changing direction. Both transport mechanisms appear to be closely associated with the dynamics of vortical structures in the wall region. GRA

N90-29589# Ballistic Research Labs., Aberdeen Proving Ground, MD.
DIRECT NUMERICAL SIMULATION OF TURBULENT COUETTE FLOW Final Report, Feb. 1989 - Mar. 1990
John D. Kuzan and Kurt D. Fickie Jun. 1990 42 p
(AD-A224287; BRL-MR-3838) Avail: NTIS HC A03/MF A01 CSCL 20/4

A direct simulation of fully developed turbulent channel flow with heat transfer was performed through a direct solution of the time-varying, incompressible, Navier-Stokes equations. Instantaneous streamwise, spanwise, and normal velocity as well as other turbulence quantities, were computed. Comparison is made with experimental measurements in the literature. There are discrepancies in the maximum values of the second- through fourth-order statistics. The maximum value of the streamwise turbulence intensity is about ten percent lower than what is found experimentally. The unusually high flatness at the wall suggests that more resolution is required near the wall to sort out the contributions of various sized structures, although calculations with less resolution seem to capture the smallest relevant scales of motion. GRA

N90-29590# California Univ., Davis.
PARTICLE DISPERSION IN A TURBULENT SHEAR FLOW Annual Report, 15 May 1989 - 14 May 1990
Ian M. Kennedy and Wolfgang Kollmann 25 May 1990 7 p
(Grant AF-AFOSR-0392-89; AF Proj. 2308)
(AD-A224327; AFOSR-90-0685TR) Avail: NTIS HC A02/MF A01 CSCL 20/4

A joint experimental and numerical study of droplet dispersion in a round turbulent jet was initiated. Laser light scattering was used to measure the motion of non-vaporizing droplets of water and hexadecane in an isothermal turbulent jet of air. The results indicated that an initial radial velocity fluctuation in the droplet motion at the jet exit can serve to increase significantly the dispersion of droplets larger than 100 microns. Vortex dynamics simulations of the near region of the jet showed that Basset, virtual mass and pressure gradient forces may be neglected for small droplets but may need to be accounted for, particularly at high pressure, with large droplets (greater than 100 microns) even if the drop to gas density ratio is close to one. A stochastic simulation of particle dispersion revealed that the Reynolds stresses or velocity correlations in this flow do not contribute significantly to particle dispersion. GRA

N90-29591# California Inst. of Tech., Pasadena.
STRUCTURE IN THE NEAR FIELD OF THE TRANSVERSE JET Ph.D. Thesis
Thomas Frank Fric 13 Apr. 1990 237 p
(Contracts N00014-89-J-1991; N00014-85-K-0646)
(AD-A224502) Avail: NTIS HC A11/MF A02 CSCL 20/4

Photographs of an axisymmetric turbulent jet issuing from a wall into a crossflow display 4 types of vortical structures which exist in the near field: jet shear layer vortices, nascent far field vortex pair, near wall horseshoe vortices, and a system of vortices in the jet wake. Results of hot-wire measurements in the wake of the transverse jet are presented. Among these results are characteristic wake Strouhal frequencies which vary with the jet/crossflow velocity ratio, and wake velocity profiles. It is found that the wake vorticity is not shed from the jet but is formed from vorticity which originated in the wall boundary layer. Thus analogies between the wakes of transverse jets and the wakes of solid cylinders are incorrect. Since the jet is not a solid obstacle to crossflow, as a cylinder is, new vorticity is not generated at the interface between the jet and the crossflow. Instead, the boundary layer on the wall from which the jet issues separates near the downstream side of the jet because it cannot negotiate the adverse pressure gradient imposed on it by the flow around the jet, which is not separated as it is for a cylinder. Wake vortices subsequently formed are found to be most coherent near a jet/crossflow velocity

ratio of 4. Near field development of the counterrotating vortex pair, which is the dominant structure of the far field jet, is also addressed. It is argued that the source of vorticity for the vortex pair is the vorticity from the boundary layer walls. GRA

N90-29592# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
DUAL AND PRIMAL MIXED PETROV-GALERKIN FINITE ELEMENT METHODS IN HEAT TRANSFER PROBLEMS
Abimael F. D. Loula and Elson Magalhaes Toledo Dec. 1988 16 p
(DE90-627190; LNCC-048/88; BR-9023165; ISSN-0101-6113)
Avail: NTIS (US Sales Only) HC A03/MF A01

New mixed finite element formulations for the steady state heat transfer problem are presented with no limitation in the choice of conforming finite element spaces. Adding least square residual forms of the governing equations of the classical Galerkin formulation, the original saddle point problem is transformed into a minimization problem. Stability analysis, error estimates, and numerical results are presented, confirming the error estimates and the good performance of this new formulation. DOE

N90-29593# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
FURTHER STUDIES OF TURBULENCE STRUCTURE RESULTING FROM INTERACTIONS BETWEEN EMBEDDED VORTICES AND WALL JETS AT HIGH BLOWING RATIOS M.S. Thesis
William D. Doner Dec. 1989 291 p
(AD-A223296) Avail: NTIS HC A13/MF A02 CSCL 20/4

Interactions of wall jets and vortices embedded in turbulent layers commonly occur near gas turbine blades and endwalls where film cooling is employed. These interactions frequently result in undesirable heat transfer effects at blade and endwall surfaces. In this thesis, a crossed hot-wire probe is used to measure the turbulence structure resulting from this type of interaction. The vortex is generated using a half delta-wing vortex generator mounted 12 deg with respect to a 10 m/s mean velocity flow over a flat plate. A single injection hole, 0.95 cm in diameter, inclined 30 deg to the horizontal, is positioned 59.3 cm downstream of the vortex generator. The vortex generator is positioned so that vortex upwash and downwash could be located over the injection hole. Streamwise development of the turbulent boundary layer was investigated for the following cases: (1) boundary layer with jet only ($m = 1.5$), and (2) boundary layer with vortex only. Measurement of interaction between the boundary layer, vortex upwash, and the wall jet was made at one station with various blowing ratios. At low blowing ratios ($m = 0.5$ and 1.5) the vortex dominates the flow. Significant alterations to the turbulent structure are seen in the Reynolds stress components, vorticity distributions and mean velocities. At higher blowing ratios ($m = 2.5$ and 3.5) the jet dominates the flow, the vortex is blown away from the wall, and its turbulence effects are dispersed over a larger area. GRA

N90-29594# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
EFFECTS OF 1 Hz IMPOSED BULK FLOW UNSTEADINESS ON LAMINAR/TURBULENT TRANSITION IN A STRAIGHT CHANNEL M.S. Thesis
Thomas M. Coumes Dec. 1989 200 p
(AD-A223396) Avail: NTIS HC A09/MF A02 CSCL 20/4

Laminar/turbulent transition is studied in a straight channel with 1 Hz imposed bulk flow unsteadiness for Reynolds numbers of 1103 to 2715 and Strouhal numbers of 0.06045 to 0.02455. Channel aspect ratio is 40 to 1 with 1.27 cm height, 50.8 cm width and 4.27 m length. Observations, videos, and photographs of smoke patterns show different subcritical transition events including Tollmien-Schlichting waves, vortex-array type motion evidence by smoke swirls and ribbon like patterns, turbulent and fully turbulent flow. Fluctuating intensity magnitudes relative to velocities from imposed unsteadiness are determined from phase-averaged velocity traces. Of particular interest is whether the imposed unsteadiness advances or delays transition events. With the conditions that were investigated, transition events begin to occur at lower Reynolds numbers and extend over a wider range of Reynolds numbers compared to flows with no imposed unsteadiness. GRA

N90-29595# California Univ., Los Angeles. Dept. of Mechanical, Aerospace, and Nuclear Engineering.
AN ADDITIVE TURBULENT DECOMPOSITION OF THE NAVIER-STOKES EQUATIONS IMPLEMENTED ON HIGHLY PARALLEL COMPUTER SYSTEMS Final Report, 1 Apr. 1989 - 31 Mar. 1990
J. M. McDonough, E. C. Hylin, Ivan Catton, Tony F. C. Chan, and T. Mathew 30 May 1990 38 p
(Grant AF-AFOSR-0281-89; AF Proj. 2307)
(AD-A223678; UCLA-ENG-6762N-87; AFOSR-90-0676TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

Progress is reported on a study of a new turbulence simulation technique based on an unaveraged, additive decomposition of the Navier-Stokes equations. The decomposition provides a natural separation of the governing equations into large- and small-scale parts, with the small scale solved on local subdomains to provide a high degree of parallelism. Results presented here include formal consistency and accuracy proofs for Burgers' and the full 3-D, incompressible Navier-Stokes equations, as well as various details of transferring information between the large- and small-scale calculations. Initial work on applying the method to the study of transition to turbulence in circular pipe flow is also documented. In addition, studies on the domain decomposition and multigrid aspects of the method, using the Schwarz alternating method and the full-approximation scheme, is included. GRA

N90-29596# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
AN INVESTIGATION OF THE INVISCID SPATIAL INSTABILITY OF COMPRESSIBLE MIXING LAYERS Ph.D. Thesis
Mei Zhuang 18 May 1990 144 p
(Grants AF-AFOSR-0155-88; AF-AFOSR-0213-83; AF Proj. 2308)
(AD-A223776; AFOSR-90-0762TR) Avail: NTIS HC A07/MF A01 CSCL 20/4

This dissertation investigates the behavior of both unbounded and bounded compressible plane mixing layers with respect to two- and three-dimensional, spatially growing wave disturbances using linear stability analysis. The mixing layer is formed by two parallel streams with different gases and the flow is assumed to be inviscid and non-reacting. For unbounded mixing layers, the effects of the free-stream Mach number, velocity ratio, temperature ratio, gas constant (molecular weight) ratio and the ratios of specific heats on the linear spatial instability characteristics of a mixing layer are determined. A nearly universal dependence of the normalized maximum amplification rate on the convective Mach number is found for two-dimensional spatially growing disturbances. The effects of the mean flow profiles on the instability behavior of the mixing layers are also studied. It is shown that decreasing the thickness of the total temperature profile relative to the mean velocity profile, or adding a wake component in the mean velocity profile can make the normalized amplification rate decrease slower as the convective Mach number increases for both subsonic and supersonic convective Mach numbers. GRA

N90-29597# Royal Aircraft Establishment, Farnborough (England).
THE EXPERIMENTAL INVESTIGATION OF FLOW IN THE CORE OF A VORTEX STRUCTURE
V. L. Bakulin and A. M. Gaifullin Jan. 1990 8 p Original language document was announced in IAA as A88-52094
(BR114893; RAE-Trans-2176) Avail: NTIS HC A02/MF A01

An experimental study is presented for quasi-conical flow for a parabolically curved wing with a parabolic planform. Two closed recirculation regions not touching the wing were observed at the wing's leading edge. An analysis is made of the effect of nonself-similar factors on the structure of the quasi-conical flow. Author

N90-29598# California Univ., Berkeley. Dept. of Mechanical Engineering.
SOLID PARTICLE EROSION IN TURBULENT FLOWS PAST TUBE BANKS
Joseph A. C. Humphrey Feb. 1990 16 p Prepared for ORNL, TN
(Contract DE-AC05-84OR-21400)
(DE90-015711; ORNL/Sub-86-55936/01) Avail: NTIS HC A03/MF A01

Judging from the extensive literature on the subject, the phenomenon of material erosion by solid particle impact continues to challenge both practitioners and theoreticians with very complex problems. Although the importance of fluid motion to this form of wear was recognized in early works, many researchers continue to interpret and attempt to understand particle impact erosion almost exclusively in terms of the material properties involved. Little attention has been given to clarifying the influence of fluid motion, especially in the turbulent flow regime. A review of some relevant issues is presented here. It starts with an exposition of the general problem and the need for better understanding. The discussion of experimental techniques is followed by various fundamental considerations relating to the motion of solid particles conditioned by the presence of a carrier fluid, neighboring particles and a constraining solid surface. Of the experimental techniques used in erosion studies, non-intrusive optical methodologies are the most promising for measuring particle and fluid phase velocities simultaneously near a surface. Numerical models for calculating particle-laden flows and their application to predict erosion in practical engineering flow configurations are briefly discussed. Emphasis is placed throughout on uncovering areas of inadequate fundamental understanding of fluid mechanics phenomena that significantly effect erosion by solid particle impact. DOE

N90-29599# Brookhaven National Lab., Upton, NY. Reactor Div.
COUNTER-CURRENT FLOW LIMITATION IN THIN RECTANGULAR CHANNELS
Lap Y. Cheng 1990 8 p Presented at the American Nuclear Society Topical Meeting on Safety of Non-Commercial Nuclear Reactor Research and Irradiation Facilities, Boise, ID, 30 Sep. - 3 Oct. 1990
(Contract DE-AC02-76CH-00016)
(DE90-015124; BNL-44836; CONF-900917-14) Avail: NTIS HC A02/MF A01

The phenomenon of counter-current flow limitation (CCFL) in thin rectangular channels is important in determining the heat removal capability of research reactors which use plate-type fuel elements similar to the MTR design. An analytical expression for predicting CCFL in narrow rectangular channels was derived from the momentum equations for the liquid and gas phase. The model assumes that the liquid downflow is in the form of a film along the narrower side walls of the channel, while the gas flow occupies the wide span of the rectangular channel. The average thickness of liquid film is related to the rate of gas flow through a stability criterion for the liquid film. The CCFL correlation agrees with air/water data taken at relatively high gas velocities. Depending on the magnitude of the dimensionless channel width, the new CCFL correlation approaches zero liquid penetration either in the form of a Wallis correlation or in terms of a Kutateladze number. The new correlation indicates that for a thin rectangular channel, the constant C in the Wallis flooding correlation depends on the aspect ratio of the channel. The approach to the appropriate asymptotic solutions also justifies the use of twice the wide span as the correct length scale for thin rectangular channels. DOE

N90-29600# Centre d'Etudes et de Recherches, Toulouse (France). Departement d'Etudes at de Recherches en Aerothermodynamique.
TRANSITION OF THE BOUNDARY LAYER Final Report [TRANSITION DE LA COUCHE LIMITE, RAPPORT DE SYNTHESE FINAL]
D. Arnal, J. C. Juillen, and F. Laburthe Jan. 1990 57 p In FRENCH
(Contract DRET-89-002-08)
(DERAT-RSF-50/5018-37; DERAT-RSF-50/5018-38; ETN-90-97556) Avail:NTIS HC A04/MF A01

The laminar turbulent boundary layer transition is investigated. The properties of stability of a three dimensional compressible laminar boundary layer and the wall suction effect on an airfoil are discussed. In the first case the flow between two cylinders in high speed flow is analyzed. Theoretical and experimental results are given for the second scenario. ESA

N90-29601# Metraflu, Eculiy (France).
TECHNIQUE FOR THE MEASUREMENT OF NOISE OF THE FLOW ASSOCIATED TO THE SMALL WAVE NUMBERS OF THE TURBULENCE SPECTRA Final Report [TECHNIQUE DE MESURE DE BRUIT D'ECOULEMENT ASSOCIE AUX PETITS NOMBRES D'ONDES D'UN SPECTRE DE LA TURBULENCE, RAPPORT FINAL]
Gilles Robert Feb. 1990 15 p In FRENCH
(Contract DRET-86-332)
(ETN-90-97558) Avail: NTIS HC A03/MF A01

A method for the measurement of the inner spectral density of the wall pressure field under a turbulent boundary layer is presented. Different experimental techniques applied in this field are analyzed. A method based on the numerical spectral analysis of the correlation function is developed. The inner-spectral measurements showed a strong asymmetry of the convection pic and the presence of secondary lobes. These characteristics are correlated with variations of the field convection velocity. Comparisons with several models are provided. ESA

N90-29602# Metraflu, Ecully (France).
SECONDARY FLOW IN PRESENCE OF WALL JETS: INCORPORATION OF COMPRESSION EFFECTS IN A QUASI-ELLIPTIC NAVIER-STOKES CALCULATION CODE Final Report [ECOULEMENTS SECONDAIRES EN PRESENCE D'INJECTIONS PARIETALES. PRISE EN COMPTE DES EFFETS DE COMPRESSIBILITE DANS LE CODE DE CALCUL NAVIER-STOKES QUASI ELLIPTIQUE, RAPPORT DE SYNTHESE FINALE]
Frederic Pommel, Pascal Ferrand, Francis Leboeuf, and Etienne Parkinson Mar. 1990 40 p In FRENCH
(Contract DRET-85-404)
(ETN-90-97559) Avail: NTIS HC A03/MF A01

A quasi-elliptic Navier-Stokes calculation code is presented. The work performed during the research program is reviewed. The effects of compressibility are considered. The method for calculating velocity and pressure field is described. The density is locally calculated by using the equation for ideal gases. The modifications are validated by the new STANITZ elbow test case. The results obtained on this elbow for compressible and incompressible flows are presented and compared with experimental data. ESA

N90-29603# Grenoble-1 Univ. (France). Lab. de Mathematiques Appliquees.
OPTIMIZATION OF TETRAHEDRICAL MESHES FOR FINITE ELEMENT CALCULATION METHODS IN FLUIDS MECHANICS [OPTIMISATION DE MAILLAGES TETRAEDRIQUES POUR LES CALCULS D'ELEMENTS FINIS EN MECANIQUE DES FLUIDES]
C. Lacote and J. Mailfert 1990 14 p In FRENCH
(Contract DRET-86-118)
(ETN-90-97560) Avail: NTIS HC A03/MF A01

The purpose of the study was to obtain optimization algorithms for a given mesh. The method proposed consists of two steps: the construction of the initial mesh and the optimization step. In the first step a cost value representing quality is attributed to each triangle or tetrahedron. In the second step optimization algorithms are developed for minimizing the object function associated with the tetrahedrization. ESA

N90-29604# Societe Bertin et Cie, Plaisir (France). Div. Mecanique des Fluides.
EXPERIMENTAL STUDY ON THE DYNAMIC BEHAVIOR OF A REVOLVING BLADE GRILL [ETUDE EXPERIMENTALE DU COMPORTEMENT DYNAMIQUE D'UNE GRILLE D'AUBES]
R. Schlegel, G. Foucat, and P. Sagnes 1 Dec. 1989 130 p In FRENCH
(Contract DRET-87-439)
(Rept-NT-89-Cc-18; ETN-90-97586) Avail: NTIS HC A07/MF A01

The experimental investigations concerning the operation of compressors in the presence of flow distortions are presented. The model implementation and the improvements in the incident flow distortion structure are described. The analysis and the results of the laser and hot film anemometry are included. A two directional weight indicator is integrated to the blade system. The experimental results are compared with theoretical models using GRINCO and TRAVIATA codes. The modeling of the unsteady response is given. ESA

N90-29605# European Space Agency, Paris (France).
CALCULATION OF FLOW FIELDS BY THE SOLUTION OF THE EULER EQUATIONS USING AN EXTENDED FINITE VOLUME DISCRETIZATION SCHEME
Cord-Christian Rossow (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Jun. 1990 193 p Trans. into ENGLISH of Berechung von Stroemungsfeldern durch Loesung der Euler-Gleichungen mit einer Erweiterten Finite-Volumen Diskretisierungsmethode Original report in GERMAN previously announced as ETN-90-96052
(ESA-TT-1204; DLR-FB-89-38; ETN-90-97597) Avail: NTIS HC A09/MF A01

Different two dimensional finite volume schemes for the spatial discretization of the Euler equations are outlined. The accuracy of these schemes is investigated by theoretical analysis. Calculations on two dimensional problems are performed with discretization methods discussed in order to demonstrate the influence of the difference discretization errors. Comparison of the results shows that in the case of discontinuities in the computational mesh, only a cell vertex scheme is capable of ensuring consistent discretization of the governing equations. The higher accuracy of the cell vertex method is retained for three dimensional problems by the use of an appropriate formulation derived. This is confirmed by theoretical analysis and by the calculation of illustrative three dimensional flow fields. ESA

N90-29606# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
NUMERICAL GRID GENERATION
1990 480 p Lecture series held in Rhode-Saint-Genese, Belgium, 11-15 Jun. 1990
(VKI-LS-1990-06; ISSN-0377-8312; ETN-90-97624) Avail: NTIS HC A21/MF A03

Differences between structured and unstructured meshes were explained and data structures for grids were discussed. Grid methods were reviewed. Aspects of flow algorithms and errors related to the computational grid, geometry modeling and surface mesh generation were discussed. Grid methods using Partial Differential Equations and assembly of triangles or tetrahedra were covered. The importance of adaptive meshes was emphasized. Adaptive techniques for the advancing front method were studied. Applications to a range of fluid dynamic problems demonstrated the technique. For individual titles, see N90-29607 through N90-29612.

N90-29607# University Coll. of Swansea (Wales). Inst. for Numerical Methods in Engineering.
GRID GENERATION
N. P. Weatherill *In* VKI, Numerical Grid Generation 1990 140 p Sponsored by RAE (For primary document see N90-29606 24-34)
Avail: NTIS HC A21/MF A03

An overview of mesh generation techniques for computational fluid dynamics is given. The methods discussed are not restricted to this area of application. Two methods for structured meshes and the Delaunay triangulation for unstructured meshes, are discussed in depth and the details given should assist the development of such schemes. The option of combining structured and unstructured meshes in an attempt to encompass, in one approach, the advantageous properties offered by each of these two mesh types, is investigated. ESA

N90-29608# Program Development Corp., White Plains, NY.
LOCAL INTERPOLATION FUNCTIONS FOR CURVE GENERATION WITH THE MULTI-SURFACE TRANSFORMATION
Peter R. Eiseman (Columbia Univ., New York, NY.) *In* VKI, Numerical Grid Generation 1990 73 p (For primary document see N90-29606 24-34)
Avail: NTIS HC A21/MF A03

Coordinate generation techniques with precise local controls were derived and analyzed for continuity requirements up to both first and second derivatives, and were projected to higher level from the projected pattern. A precision of the local controls was obtained when a family of local coordinate surfaces was uniformly distributed without a consequent creation of flat spots on the coordinate curves transverse to the family. The redistribution process was described. ESA

N90-29609# Program Development Corp., White Plains, NY.
THE CONTROL POINT FORM OF ALGEBRAIC GRID GENERATION
Peter R. Eiseman *In* VKI, Numerical Grid Generation 1990 39 p (For primary document see N90-29606 24-34)
(Contract F49620-89-C-0096)
Avail: NTIS HC A21/MF A03

The control point form of algebraic grid generation is developed in a rigorous manner to ellucidate the key attributes of the mathematical theory and is demonstrated graphically to visualize the type of action that is possible. Altogether, the algebraic coordinate transformation represents a flexible structure that is adaptable to various situations. The effective free form modeling of the boundaries of objects in a field about which a numerical simulation is to be performed with the generated grid is presented. ESA

N90-29610*# Program Development Corp., White Plains, NY.
THE FUNDAMENTALS OF ADAPTIVE GRID MOVEMENT
Peter R. Eiseman (Columbia Univ., New York, NY.) *In* VKI, Numerical Grid Generation 1990 85 p (For primary document see N90-29606 24-34)
(Grants NAG3-715; AF-AFOSR-0307-86)
Avail: NTIS HC A21/MF A03

Basic grid point movement schemes are studied. The schemes are referred to as adaptive grids. Weight functions and equidistribution in one dimension are treated. The specification of coefficients in the linear weight, attraction to a given grid or a curve, and evolutionary forces are considered. Curve by curve and finite volume methods are described. The temporal coupling of partial differential equations solvers and grid generators was discussed. ESA

N90-29611*# Imperial Coll. of Science and Technology, London (England).
UNSTRUCTURED MESH METHODS FOR CFD
J. Peraire, K. Morgan, and J. Peiro *In* VKI, Numerical Grid Generation 1990 121 p Sponsored in cooperation with UK Science and Engineering Research Council; Avions Marcel Dassault; and Cray UK (For primary document see N90-29606 24-34)
(Contract NCCw-008; NAGw-478; NAGw-1809)
Avail: NTIS HC A21/MF A03

Mesh generation methods for Computational Fluid Dynamics (CFD) are outlined. Geometric modeling is discussed. An advancing front method is described. Flow past a two engine Falcon aeroplane is studied. An algorithm and associated data structure called the

alternating digital tree, which efficiently solves the geometric searching problem is described. The computation of an initial approximation to the steady state solution of a given poblem is described. Mesh generation for transient flows is described.
ESA

N90-29612# Mississippi State Univ., Mississippi State.
ELLIPTIC GRID GENERATION Abstract Only
J. F. Thompson *In* VKI, Numerical Grid Generation 1990 2 p (For primary document see N90-29606 24-34)
Avail: NTIS HC A21/MF A03

The particular choice of elliptic partial differential equations and the relevant properties of these equations in relation to the grids produced were studied. The incorporation of control functions in the generation system to control the spacing and orientation of the grid was covered. The automatic evaluation of these control functions from initial algebraic grids or from boundary point distributions was discussed as well as the iterative adjustment of control functions for boundary orthogonality with specified spacing. Methods for the solution of the generation system were presented, including evaluation of locally optimum acceleration parameters. No notes are provided but references are given. ESA

N90-29613# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.). Inst. fuer Theoretische Stromungsmechanik.
A NUMERICAL STUDY OF THE RESPONSE OF THE LAMINAR UNSTEADY SEPARATED FLOW ABOUT A CIRCULAR CYLINDER TO CHANGES OF BOUNDARY CONDITIONS
Yi-Chuin Sun, Shanfu Shen, and Nanqian Chen (Beijing Inst. of Aeronautics and Astronautics, China) 1990 114 p
(DLR-FB-90-10; ISSN-0171-1342; ETN-90-97625) Avail: NTIS HC A06/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 41.50 Deutsche marks

An extensive investigation of the effective possibilities of controlling the laminar unsteady separated flow about a circular cylinder (backside wall bleeding, backside wall suction, local tangential wall motion) is made by way of the numerical simulation on the basis of the Navier-Stokes equations. The objectives of flow control are aimed at the reduction of flow resistance (strongly dependent on flow separation) and the alleviation of the fluctuating normal forces (strongly dependent on vortex shedding). According to the investigations, it is apparent that in the application of the control measures attention should paid to the different aspects of their consequences. A control measure that reduces the flow resistance may however aggravate the fluctuation of normal forces and vice versa. The optimal control can be achieved through local tangential wall motion with velocities of a fictitious potential flow.
ESA

N90-29614# National Aerospace Lab., Tokyo (Japan).
APPROXIMATE EQUATIONS FOR HEAT CONDUCTION IN MULTI-LAYERED CYLINDRICAL SHELLS
Shuji Endo Dec. 1989 25 p In JAPANESE; ENGLISH summary
(NAL-TR-1049; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A system of two coupled two-dimensional heat conduction equations for multi-layered cylindrical shells, whose layers are in perfect thermal contact, is formulated as a first approximation, consistent with the Kirchhoff-Love hypothesis in the theory of shells. This system of equations is deduced from the exact three-dimensional heat conduction equation, by expanding the temperature function into an infinite series of Legendre polynomials with respect to the thickness coordinate of each layer. Some analytical examples of heat conduction problems are then given for the special cases where the resulting heat conduction equations can be decoupled. Author

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N90-29615*# Lockheed Engineering and Sciences Co., Hampton, VA.
DESIGN AND EVALUATION OF CANDIDATE PRESSURE DISTRIBUTION AND AIR DATA SYSTEM TILE PENETRATION FOR THE AEROASSIST FLIGHT EXPERIMENT Final Report, Sep. 1988 - Apr. 1989
Alfred E. VonTheumer Washington NASA Sep. 1990 217 p Presented at the Pressure Data and Air Data System Preliminary Design Review, Hampton, VA, 10 May 1989 and at the Base Flow Heating Experiment Preliminary Design Review, Houston, TX, 15 May 1989
(Contract NAS1-19000)
(NASA-CR-4312; NAS 1.26:4312) Avail: NTIS HC A10/MF A02 CSCL 14B

This program objectives were to produce a pressure measurements system that penetrates the thermal protection system of a spacecraft and is able to obtain accurate pressure data. The design was tested vibro-acoustically, aerothermally, and structurally and found to be adequate. This design is a possible replacement of the current pressure system on the orbiter.
Author

N90-29616# Department of Energy, Washington, DC.
LEAK DETECTION AID Patent Application
Timothy J. Steeper, inventor (to DOE) (Du Pont de Nemours, E. I. and Co., Aiken, SC) 15 Feb. 1989 9 p
(Contract DE-AC09-76SR-00001)
(DE90-014678; US-Patent-Appl-SN-310556;
Patents-US-A7310556) Avail: NTIS HC A02/MF A01

A leak detection apparatus and method for detecting leaks across an O-ring sealing a flanged surface to a mating surface is an improvement in a flanged surface comprising a shallow groove following O-ring in communication with an entrance and exit port intersecting the shallow groove for injecting and withdrawing, respectively, a leak detection fluid, such as helium. A small quantity of helium injected into the entrance port will flow to the shallow groove, past the O-ring and to the exit port. DOE

N90-29617# New Mexico Univ., Albuquerque. Center for Advanced Studies.
NOVEL APPROACHES TO SENSITIVITY ENHANCEMENT OF RING LASER GYROS Final Report
Marlan O. Scully Jun. 1990 12 p
(AD-A224335) Avail: NTIS HC A03/MF A01 CSCL 09/3

The role of quantum effects and determining how the sensitivity of optical sensor, such as the ring-laser gyro, can be improved was studied. The correlated-spontaneous-emission laser (CEL) is a concept which permits reduction of quantum noise associated with the relative phase angle between two correlated laser transitions. The mechanism of quantum noise quenching in the original CEL device (quantum beat laser) has been explained using a geometrical approach, and a more rigorous analysis where amplitude noise is also included. Extensive studies on the CEL, including the effects of nonlinear saturation and atomic motion, was performed. The CEL concept has been found applicable to various types of devices, besides the quantum beat laser, for the purpose of quantum noise reduction. GRA

N90-29618# Dayton Univ., OH. Research Inst.
A 94 GHz TRANSMISSOMETER Final Technical Report, Jul. 1984 - Sep. 1985
Thomas J. Barnum May 1990 144 p

(Contract F30602-81-C-0206; AF Proj. 2688)
(AD-A223309; UDR-716736-1; RADC-TR-90-69) Avail: NTIS HC A07/MF A01 CSCL 17/9

The physical implementation of a 94 GHz reflection transmissometer is documented. The instrument operates by reflecting a signal from a calibrated target but differs from a radar in that no range gate is used. The design is discussed and signals in the receiver are analyzed in order to document the operation and to ease troubleshooting. Test results are given both for calibration with an internal signal loop provided for that purpose and for outdoor tests with corner reflectors. The test results show that the transmissometer functions properly, although at a somewhat reduced range due to less return from the target than was predicted. The range is also limited by clutter which dominates the signal return at long ranges. The use of a modulated target is suggested to alleviate this problem, and a preliminary modulated target design is discussed. GRA

N90-29619# Naval Postgraduate School, Monterey, CA.
APPARATUS TO DETERMINE THE COMPLEX MASS OF A VISCOUS FLUID CONTAINED IN A RIGID POROUS SOLID FROM ACOUSTIC PRESSURE MEASUREMENTS M.S. Thesis
Robert Allen Mirick Dec. 1989 52 p
(AD-A223709) Avail: NTIS HC A04/MF A01 CSCL 17/1

Two experimental techniques to determine the frequency-dependent complex mass of a viscous fluid contained in a rigid porous solid are investigated. In one technique the moving mass of the fluid is measured by its effect on the measured input electrical impedance of a moving coil transducer. In the second technique the moving mass is extracted from the measured acoustic pressure required for the fluid to oscillate with a known amplitude through the solid frame. A description of the apparatus and preliminary results using the pressure method as well as a comparison of the two techniques are presented. GRA

N90-29620# Lawrence Livermore National Lab., CA.
EVALUATION OF DYNAMIC RANGE FOR LLNL STREAK CAMERAS USING HIGH CONTRAST PULSES AND PULSE PODIATRY ON THE NOVA LASER SYSTEM
J. B. Richards, T. L. Weiland, and J. A. Prior Jul. 1990 8 p Presented at the SPIE's 19th International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract W-7405-eng-48)
(DE90-015203; UCRL-JC-104456; CONF-900756-32) Avail: NTIS HC A02/MF A01

A standard Lawrence Livermore National Laboratory (LLNL) streak camera has been used to analyze high contrast pulses on the Nova laser facility. These pulses have a plateau at their leading edge (foot) with an amplitude which is approximately 1 percent of the maximum pulse height. Relying on other features of the pulses and on signal multiplexing, we were able to determine how accurately the foot amplitude was being represented by the camera. Results indicate that the useful single channel dynamic range of the instrument approaches 100:1. DOE

N90-29621# Lawrence Livermore National Lab., CA.
LONG-TERM FLAT-FIELD BEHAVIOR IN LLNL STREAK CAMERAS: PRELIMINARY RESULTS
J. A. Hatch, D. S. Montgomery, and J. Prior Jun. 1990 6 p Presented at the SPIE's 19th International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract W-7405-eng-48)
(DE90-015615; UCRL-JC-104455; CONF-900756-33) Avail: NTIS HC A02/MF A01

The flat-field profile of Lawrence Livermore National Laboratory (LLNL) streak cameras fitted with either S-1 or S-20 photocathode tubes is monitored and updated periodically. This paper will describe how these streak camera flat-fields change over the course of 12 to 25 months as well as research into the processes which drive this degradation. DOE

N90-29622*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
INTEGRATED CONTROLS AND HEALTH MONITORING FIBEROPTIC SHAFT MONITOR Final Report
P. Coleman, H. Darejeh, and J. J. Collins Nov. 1989 28 p Original contains color illustrations
(Contract NAS3-23773)
(NASA-CR-185210; NAS 1.26:185210; RI/RD-90-177) Avail: NTIS HC A03/MF A01; 2 functional color pages CSCL 14B

Recent work was performed on development optical technology to provide real time monitoring of shaft speed, shaft axial displacement, and shaft orbit of the OTVE hydrostatic bearing tester. Results show shaft axial displacement can be optically measured (at the same time as shaft orbital motion and speed) to within 0.3 mills by two fiber optic deflectometers. The final results of this condition monitoring development effort are presented. Author

N90-29623 Physics and Electronics Lab. TNO, The Hague (Netherlands).
DETECTORS AND SIGNAL PROCESSING FOR THE SPEED MEASURING SYSTEM 4-01
J. vanderHaven and G. J. Proper Mar. 1989 126 p In DUTCH; ENGLISH summary
(Contract A79/KL/095)
(FEL-1989-64; TD-89-2325; ETN-90-97400) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, The Netherlands

The speed measuring system 4-01 is presented. The optronic detectors and the analog circuits in the central processing unit of an optical speed measuring system are described. This system intends to measure the speed of small caliber projectiles with a tolerance of one promille. The detection of a projectile can take place close to the gun as well as at larger distances. A projectile with a caliber of 5.5 mm can be detected at a height of 6.5 m. The measuring system can still be used when the intensity of radiation is 500 lux. ESA

N90-29624# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Messtechnik und Sensoren.
ON THE TECHNOLOGY FOR PREPARATION OF A HeNe DISCHARGE TUBE FOR USE IN A LASER GYRO
Rudolf Neubauer and Werner Jungbluth 1990 42 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1222)
(DLR-Mitt-90-01; ISSN-0176-7739; ETN-90-97536) Avail: NTIS HC A03/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Rep. of Germany, 17.50 Deutsche marks

A gas discharge tube with anodes and Brewster windows is necessary to produce coherent light in order to perform a ring laser gyro. To obtain a high life time, some properties of the chosen material are important, such as a weak light absorption, a high chemical resistance of the glass, a good polarizability and a minimal helium permeability. A soft glass was selected, ultrasound machined where necessary, and the tube was joined by using a glass soldering technique. For the detection of the helium leak, mass spectroscopy was used. A soldered helium-neon discharge tube without any getter was tested in a linear resonator and produced a laser radiation during 25,000 hours. ESA

N90-29625# National Aerospace Lab., Tokyo (Japan).
CHARACTERISTICS OF PUSHBROOM SCANNING TYPE RADIOMETER UTILIZING LINEAR SENSORS
Kohzo Homma, Hajime Koshiishi, and Masao Naka Jun. 1989 34 p In JAPANESE; ENGLISH summary
(NAL-TR-1024; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

It is anticipated that the pushbroom scanning scheme will be used very widely in future airborne and spaceborne imaging spectrometers for remote sensing, because of its potential capability for high resolution and high reliability. At NAL two pushbroom imaging spectrometers, were produced for test purposes, one for aircraft and the other for spacecraft. Both utilize

a CCD linear array for the opto-electronic sensor elements. This is the first attempt to apply the pushbroom scan scheme to airborne spectrometers. Small refracting optics (lens system) were used to get a very wide viewing angle. The optics were able to collect sufficient radiative energy. The dimensions of this airborne spectrometer system are very small compared to the customary systems, which have to have very large dimensions. For the spaceborne spectrometer a sort of cata-dioptic (reflect-refractive) optics was applied, the so called Wright-Schmidt telescope, as the collecting optics. This telescope has not such a wide viewing angle, but has very high resolution and a planar focal plane. This planar focal plane is a necessary condition for a CCD sensor arrangement. This utilization of cata-dioptic optics for imaging spectrometer is also the first attempt in a spaceborne imaging spectrometer. If the usual lens system is used for the collecting optics, the system dimension and weight will be huge because of the long focal length and large aperture. The optical performances of collecting optics for these airborne and spaceborne imaging spectrometers, the opto-electronic characteristics of the CCD linear array, and the performances of the electronics were measured and analyzed. Then the total performances of the airborne and spaceborne spectrometers were measured. As a result, some problem areas for such future airborne and spaceborne pushbroom scanning radiometers were clarified. Author

N90-29626# National Aerospace Lab., Tokyo (Japan).
A METHOD OF DETERMINING A LASER-VELOCIMETER FOCAL POINT AND MEASURING ITS BEAM PROPERTIES USING A HOT-WIRE ANEMOMETER
Shohei Takagi and Katsuichi Murota Nov. 1989 12 p In JAPANESE; ENGLISH summary
(NAL-TR-1043; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A simple method was developed to determine the focal point of the Laser 2 Focus velocimeter. The method requires only a conventional hot-wire anemometer, which traverses the dual beams at diverse beam-axis locations. The squared hot-wire bridge output indicates the mean value of the beam intensity exposed on the hot-wire element. Eventually, the maximal bridge output along the beam axis is referred to as the focal point. Furthermore, the method can be extended to measure laser-beam properties such as beam separation, beam diameter, relative beam intensity on the dual beams, beam divergence, and cross-sectional beam-intensity distribution. Measurement error in determining the beam diameter is estimated by using a simple beam model. Author

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N90-29627# Colorado Univ., Boulder. Dept. of Chemistry.
CHEMICAL STABILIZATION OF LASER DYES Final Report, 1 Apr. 1987 - 31 Mar. 1990
Tad H. Koch 10 Apr. 1990 9 p
(Contract DAAL03-87-K-0053)
(AD-A224219; ARO-23981.2-CH) Avail: NTIS HC A02/MF A01 CSCL 09/3

Irradiation of ethanol solutions of coumarin laser dye lasers produces products which absorb at the lasing wavelength. This results in attenuation of dye laser output through interference of stimulated emission. A major photoprocess which produces material which absorbs at the lasing wavelength is dye sensitized solvent oxidative oligomerization, producing aldehydic and ketonic products. A dye laser stabilization technique is removal of these carbonyl compounds as they are formed by reduction with a polymer bound borohydride reducing agent. GRA

N90-29628# Stanford Univ., CA. Lab. of Physics.
LASER PHYSICS AND LASER SPECTROSCOPY Final Report, 15 Sep. 1988 - 14 Nov. 1989
Robert L. Byer Apr. 1990 85 p
(Grant AF-AFOSR-0354-88; AF Proj. 2301)
(AD-A224379; AFOSR-90-0776TR) Avail: NTIS HC A05/MF A01 CSCL 09/3

Two essential difficulties must be addressed in any low-power frequency conversion device; boosting the efficiency above that of simple single-pass bulk devices (which are typically less than 1 percent/W) and achieving phase-matching for the desired interaction. Waveguide interactions were used to increase the conversion efficiency, and explored quasi-phase-matching (QPM) as a broadly applicable approach to meeting the phasematching condition. Both oxide forrelectrics like LiNbO3 and quantum-wells in III-V semiconductors have been investigated for these applications. Second harmonic generation (SHG) of near-infrared lasers to produce green and blue radiation, as well as SHG of the 9 to 11 micrometer output of a CO2 laser have been demonstrated in these materials. These media together constitute a significant step towards the goal of generic nonlinear media for the far infrared - ultraviolet, based on readily available materials and fabricated with standard technologies, applicable to essentially any frequency conversion application. GRA

N90-29629# Department of the Navy, Washington, DC.
LASER BEAM STOP Patent Application
Richard B. Thompson, inventor (to Navy) 13 May 1990 11 p
(AD-D014595; US-Patent-Appl-SN-531422) Avail: NTIS HC A03/MF A01 CSCL 09/3

A laser beam stop is constructed having a uniquely designed cell filled with a solution or suspensions of an absorbing species chosen to absorb the wavelength of light emitted by the laser. The position and strength of the laser beam are indicated by the strength and depth of penetration of the fluorescence excited by the laser. GRA

N90-29630# Department of the Navy, Washington, DC.
AN X RAY SOURCE FOR LITHOGRAPHY Patent Application
Phillip Sprangle, inventor (to Navy), Bahman Hafizi, inventor (to Navy), and Frederick Mako, inventor (to Navy) 9 May 1990 21 p
(AD-D014596; US-Patent-Appl-SN-520229) Avail: US Patent and Trademark Office CSCL 13/8

This patent application discloses an x ray lithography device in which a beam of electrons interacts with a microwave field of a quasi-optical maser such as a quasi-optical gyrotron. This maser comprises a pair of spaced mirrors defining a quasi-optical cavity there between, with one mirror being provided with an orifice to permit extraction of the x ray beam produced. A Bragg reflector is connected to the mirror orifice to reduce the microwave power loss from the device through the orifice. Electrons injected in the maser cavity are caused to wiggle by the interacting microwave field, which functions as an undulator, so as to produce a noncoherent x ray beam that travels along the longitudinal axis of the cavity and exits through the mirror orifice. GRA

N90-29631# Naval Ocean Systems Center, San Diego, CA.
PYRROMETHENE-BF2 COMPLEXES AS LASER DYES Technical Report No. 17, 1 Jun. 1989 - 31 May 1990
Mayur Shah, Kannappan Thangaraj, Mou-Ling Soong, Lionel T. Wolford, Joseph H. Boyer, Ieva R. Politzer (Xavier Univ. of Louisiana, New Orleans.), and Theodore G. Pavlopoulos 24 May 1990 27 p Submitted for publication
(Contract N00014-90-WX-24290)
(AD-A223562) Avail: NTIS HC A03/MF A01 CSCL 07/3

In 1984, less than two decades after its discovery, a review described the dye laser as one of the most useful and practical of tunable coherent sources. Laser dye activity was presumed to reflect a casual relationship with various ancillary properties including photostability, solubility and other interactions with solvent, fluorescence quantum yield, molar extinction of absorption, and minimal overlap of fluorescence with onset of absorption spectral regions, (S-S) and triplet-triplet (T-T). Bathochromic and hyperchromic shifts were introduced by the substitution of auxochromic and antiauxochromic groups but this benefit was often offset by the ability of certain groups, e.g., nitro, cyano, and heavy

atoms, to quench laser activity. Since the known dyes were each deficient in one or more properties, the search for new structures to offer superior performance standards was undertaken. GRA

N90-29632# Northeast Semiconductor, Inc., Ithaca, NY.
INNOVATIVE TECHNIQUES FOR THE PRODUCTION OF LOW COST 2D LASER DIODE ARRAYS Final Report
May 1990 17 p
(Contract N00014-89-C-0230)
(AD-A223575) Avail: NTIS HC A03/MF A01 CSCL 13/8

The objective of this program was to develop a low cost fabrication method for high performance laser diode arrays. The program focussed on reliable and cost effective ways to grow, assemble and test diode bars of molecular beam epitaxy material. Quantum well laser structures were grown on 2 and 3 GaAs substrates. These wafers were photolithographically processed, scribed into bars, and the bars assembled by various techniques. The assemblies were tested for performance, reproducibility, and reliability. The originally proposed assembly, a grooved BeO block, was evaluated and abandoned as unreliable. However, a simplified bar and individual BeO substrate assembly method was developed, and state of the art results achieved on robust 1 cm linear diode arrays, which survived repeated high power testing to power level in excess of 80 watts/bar. This method may be scaled up for multiple bar assemblies without additional complexity by adding laser bars and BeO spacers as required. The BeO sub-mounts are coated prior to assembly in such a fashion to provide a low resistance series connection to each bar in the array, similar to the grooved substrate series connection geometry. GRA

N90-29633# Maryland Univ., College Park. Lab. for Plasma Research.
HIGH AVERAGE POWER CW FELS (FREE ELECTRON LASER) FOR APPLICATION TO PLASMA HEATING: DESIGNS AND EXPERIMENTS
J. H. Booske, V. L. Granatstein, D. J. Radack, T. M. Antonsen, Jr., S. Bidwell, Y. Carmel, W. W. Destler, P. E. Latham, B. Levush, and I. D. Mayergoyz et al 1989 11 p Presented at the 11th International Free Electron Laser Conference, Naples, Italy, 28 Aug. - 1 Sep. 1989 Prepared in cooperation with Science Applications International Corp., McLean, VA
(Contract DE-FG05-87ER-52147)
(DE90-011085; CONF-8908134-31) Avail: NTIS HC A03/MF A01

A short period wiggler (period approximately 1 cm), sheet beam free electron laser (FEL) has been proposed as a low-cost source of high average power (1 MW) millimeter-wave radiation for plasma heating and space-based radar applications. Recent calculation and experiments have confirmed the feasibility of this concept in such critical areas as RF wall heating, intercepted beam current, and high voltage (0.5 to 1 MV) sheet beam generation and propagation. Results of preliminary low-gain sheet beam FEL oscillator experiments using a field emission diode and pulse line accelerator have verified that lasing occurs at the predicted FEL frequency. Measured start oscillation currents also appear consistent with theoretical estimates. Finally, we consider the possibilities of using a short-period, superconducting planar wiggler for improved beam confinement, as well as access to the high gain, strong pump Compton regime with its potential for highly efficient FEL operation. DOE

N90-29634# Lawrence Livermore National Lab., CA.
MODEL CALCULATIONS FOR A 600 ANGSTROM LASER BASED ON PHOTOPUMPING OF Mo(SUP 6+) BY A SPECTRAL LINE OF Mo(SUP 11+)
M. Klapisch, M. Cohen, W. H. Goldstein, and U. Feldman (Naval Research Lab., Washington, DC.) Jul. 1989 16 p Presented at the 9th International Conference on Vacuum Ultraviolet Radiation Physics, Honolulu, HI, 17-21 Jul. 1989
(Contract W-7405-eng-48)
(DE90-015202; UCRL-101555; CONF-8907130-6) Avail: NTIS HC A03/MF A01

We assess aspects of the feasibility of a recent proposal to use the coincidence between a Mo (11+), 136.499 angstrom line and a 4p(6 minus) 4p(5) sub 1/2 6s, J = 1, transition of Mo(6+), to obtain amplified spontaneous emission around 600 angstroms. A collisional-radiative model for the Mo(6+) ion, including resonant photoexcitation of the 4p(5) sub 1/2 6s level, was constructed using the HULLAC atomic physics package. The model included the 4s(2); 4p(6); 4p(5) 4d,4f; 4p(5) 5s,5p,5d; 4p(5) 6s,6p,6d; 4s4p(6) 4d,4f; 4p(6) 4d(2) and 4s(2) 4p(4) 4d(2) configurations, amounting to 193 levels. All configuration interactions and collisional mixing was taken into account. A gain of 3 cm (minus 1) is obtained for the 4p(5) 6s(J = 1)--4p(5) 5p(J = 2) transition at 645 angstroms with T sub e = eV, n sub e = 10(18) cm (minus 3), and an effective radiation temperature of T(sub rad) greater than 40 eV for the pump transition. Other transitions exhibit lower gains. DOE

N90-29635# EG and G Mound Applied Technologies, Miamisburg, OH.
FINITE DIFFERENCE MODELING OF LASER DIODE IGNITED COMPONENTS
D. W. Ewick 1990 19 p Presented at the 15th International Pyrotechnics Seminar, Boulder, CO, 9-13 Jul. 1990
(Contract DE-AC04-88DP-43495)
(DE90-015652; MLM-3645(OP); CONF-900792-9) Avail: NTIS HC A03/MF A01

The ignition characteristics of a laser diode ignited pyrotechnic component were modeled by using a finite difference technique to solve the governing time-dependent heat transfer equation. The model was used to calculate the ignition time of Ti/KClO4 and a CP/carbon black blend at various laser power levels. The effect of temperature on the laser ignition threshold of these materials was investigated over a range of -54 to 74 C. The impact was found to be more significant for CP/carbon black than for TiKClO4 because the latter has a higher auto-ignition temperature. The effect of the laser pulse rise time on ignition time was found to be significant only at relatively high power levels. The effects of both quartz and sapphire windows on the ignition threshold on CP/carbon black were also modeled. Because of beam divergence and conduction losses, these windows significantly affected the time-to-ignition and the laser ignition threshold. DOE

N90-29636# Royal Signals and Radar Establishment, Malvern (England).
THEORETICAL AND EXPERIMENTAL COMPARISON OF INFRARED AND VISIBLE LASER SCATTERING FROM A VARIETY OF SURFACE TYPES
D. L. Jordan, R. C. Hollins, E. Jakeman, and A. Prewett Mar. 1990 23 p
(RSRE-Memo-4348; BR114075; ETN-90-97606) Copyright Avail: NTIS HC A03/MF A01

A comparison is made between theoretical prediction of the angular distribution of laser radiation scattered from a variety of rough surfaces and experimental measurements of a fractal one. The surfaces were initially well characterized using a mechanical stylus instrument to determine the surface profiles. Scattering experiments were carried out using both transmissive and reflective geometries and both visible and infrared radiation. The results show that fractal models are appropriate in the infrared region, whereas single scale models give better agreement with experimental results in the visible region. ESA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N90-29637*# South Carolina Univ., Columbia. Dept. of Mechanical Engineering.
THERMAL ANALYSES OF POWER SUBSYSTEM COMPONENTS Final Technical Report, May 1988 - Dec. 1989
Jeffrey H. Morehouse 15 Feb. 1990 50 p

(Grant NAG9-311)
(NASA-CR-186314; NAS 1.26:186314) Avail: NTIS HC A03/MF A01 CSCL 13I

The hiatus in the Space Shuttle (Orbiter) program provided time for an in-depth examination of all the subsystems and their past performance. Specifically, problems with reliability and/or operating limits were and continue to be of major engineering concern. The Orbiter Auxiliary Power Unit (APU) currently operates with electric resistance line heaters which are controlled with thermostats. A design option simplification of this heater subsystem is being considered which would use self-regulating heaters. A determination of the properties and thermal operating characteristics of these self-regulating heaters was needed. The Orbiter fuel cells are cooled with a freon loop. During a loss of external heat exchanger coolant flow, the single pump circulating the freon is to be left running. It was unknown what temperature and flow rate transient conditions of the freon would provide the required fuel cell cooling and for how long. The overall objective was the development of the thermal characterization and subsequent analysis of both the proposed self-regulating APU heater and the fuel cell coolant loop subsystem. The specific objective of the APU subsystem effort was to determine the feasibility of replacing the current heater and thermostat arrangement with a self-regulating heater. The specific objective of the fuel cell coolant subsystem work was to determine the tranient coolant temperature and associated flow rates during a loss-of-external heat exchanger flow. Author

N90-29638# National Inst. of Standards and Technology, Gaithersburg, MD. Robot Systems Div.
CONCEPT FOR A REFERENCE MODEL ARCHITECTURE FOR REAL-TIME INTELLIGENT CONTROL SYSTEMS (ARTICS)
J. Albus, R. Quintero, R. Lumia, M. Herman, and R. Kilmer Apr. 1990 35 p
(PB90-220286; NIST/TN-1277) Avail: NTIS HC A03/MF A01; also available SOD HC $2.00 as 003-003-03011-2 CSCL 13I

A concept for the development of a reference model open-system architecture for real-time, sensory interactive, intelligent machine systems is presented. Central to this notion is a desire to accelerate technological development, technology transfer and commercialization of world class control system products in the field of robotics, intelligent machines and automation. A plan is outlined whereby a reference model Architecture for Real-Time Intelligent Control Systems (ARTICS) can be defined through the cooperative efforts of industry, academia and government. As envisioned ARTICS would be a series of evolving guidelines specifying an infrastructure of hardware components, software components, interfaces, communications protocols and application development tools. An ARTICS reference model would make it possible for industry to develop and market a diverse line of control system components which could be interchangeable and realizable on many different vendors' intelligent machine systems platforms. GRA

N90-29639 California Univ., Los Angeles.
ROBUST DESIGN OF LQG CONTROLLERS Ph.D. Thesis
Jong-Yih Lin 1989 188 p
Avail: Univ. Microfilms Order No. DA9014209

A method for robust design of multivariable controllers is proposed and developed. The method is based on a Linear Quadratic Gaussian (LQG) formulation and it is applicable to linear systems with modeling errors due to uncertain parameters in the state space equations describing the plant, its inputs, and outputs. Modeling errors due to neglected dynamics can also be treated within this framework. The acronym LQG/PRE standing for Linear Quadratic Gaussian design with Parameter Robustness Enhancement is used to refer to this method. The LQG/PRE method provides a mechanism for modifying robustness matrices. Application of the method involves describing the structure of the parameter errors using an input/output decomposition technique. The factors of these decompositions are used to formulate a modified LQG problem containing six new scalar design parameters. Conditions are developed under which the high gain approach asymptotically recovers the robustness of full-state feedback and the low gain approach makes the closed-loop poles asymptotically insensitive to parameter errors. Several examples are presented to illustrate the properties and effectiveness of both approaches. The relationships between the LQG/PRE method and previous design methods such as Parameter Robust LQG design (PRLQG), LQG with Loop Transfer Recovery (LQG/LTR), and Model Error Sensitivity Suppression (MESS) are examined. Relationships between the LQG/PRE method and the use of Frequency Weighted Cost Functionals are also discussed. Dissert. Abstr.

N90-29640 Case Western Reserve Univ., Cleveland, OH.
ROTORDYNAMIC PROPERTIES OF HIGH PRESSURE SEALS: AN EXPERIMENTAL APPROACH Ph.D. Thesis
Tachung Yang 1989 504 p
Avail: Univ. Microfilms Order No. DA9012409

An experimental facility for extracting the twelve coefficients of the linear anisotropic rotordynamic model for seals and journal bearing was developed and constructed. A double-spool-shaft spindle design is the heart of the test facility, allowing independent control over the shaft spin speed and circular orbit frequency for both forward and backward whirls. The static and dynamic eccentricities of the shaft can be adjusted. By accurately measuring the fluid interaction forces and the shaft dynamic displacements over a wide range of orbit frequencies, the rotordynamic stiffness, damping and inertia coefficients can be evaluated using an assumed linear mechanical impedance model. The implementation of two independent force measuring systems permits self-checking of the critical force measurements and thus the experimental results. A high-speed data acquisition system was developed and implemented specifically for this test facility. Software (DAAS) was developed for the high speed data acquisition (A/D), data reduction, and the calculation of the rotordynamic coefficients using the assumed linear model. Rotordynamic coefficients obtained show an expected isotropic trend for deep grooved seals, and their values are within the expected orders of magnitude. A finite element based computational analysis was used to demonstrate the overall influence of seals on vibration of a typical high energy multi-stage centrifugal pump that utilizes several rotordynamically influential interstage seals. Dissert. Abstr.

N90-29641# Department of Energy, Washington, DC.
THE dc ARC WELD STARTER Patent Application
Richard H. Campiotti, inventor (to DOE) and James E. Hopwood, inventor (to DOE) (Sandia National Labs., Albuquerque, NM.) 17 Feb. 1989 12 p
(Contract DE-AC04-76DP-00789)
(DE90-014679; US-Patent-Appl-SN-311781;
Patents-US-A7311781) Avail: NTIS HC A03/MF A01

A system for starting an arc for welding uses three dc power supplies, a high voltage supply for initiating the arc, an intermediate voltage supply for sustaining the arc, and a low voltage welding supply directly connected across the gap after the high voltage supply is disconnected. DOE

N90-29642# Rockwell International Corp., Golden, CO.
NON-CONTACT CONTOUR GAGE Patent Application
Lothar F. Bieg, inventor (to DOE) Feb. 1989 29 p
(Contract DE-AC04-76DP-03533)
(DE90-014672; US-Patent-Appl-SN-308074;
Patents-US-A7308074) Avail: NTIS HC A03/MF A01

A fluid probe for measuring the surface contour of a machined part is provided whereby the machined part can remain on the machining apparatus during surface contour measurement. A measuring nozzle in a measuring probe directs a measuring fluid flow onto the surface. The measuring nozzle is on the probe situated midway between two guide nozzles that direct guide fluid flows onto the surface. When the guide fluid flows interact with the surface, they cause the measuring flow and measuring probe to be oriented perpendicular to the surface. The measuring probe includes a pressure chamber whose pressure is monitored. As the measuring fluid flow encounters changes in surface contour,

pressure changes occur in the pressure chamber. The surface contour is represented as data corresponding to pressure changes in the pressure chamber as the surface is scanned. DOE

N90-29643# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Fire Support Armament Center.

TIP-POSITION CONTROL OF A FLEXIBLE BEAM: MODELING APPROACHES AND EXPERIMENTAL VERIFICATION Technical Report, Sep. 1988 - Sep. 1989

M. Mattice, N. Coleman, and K. Craig (Rensselaer Polytechnic Inst., Troy, NY.) Jun. 1990 66 p
(AD-A224249; ARFSD-TR-90003) Avail: NTIS HC A04/MF A01 CSCL 20/11

The dynamic modeling part of an experimental/theoretical effort is presented to develop and test pointing and tracking control techniques for a mechanical system containing both rigid and flexible bodies. Recently much work has been done to model open loop chains of rigid and elastic bodies with application to kinematic linkages, spacecraft, and manipulators. GRA

N90-29644# Naval Coastal Systems Center, Panama City, FL. Hydromechanics Branch.

MODELING TOWED CABLE SYSTEM DYNAMICS Technical Memorandum

J. W. Kamman and T. C. Nguyen May 1990 31 p
(AD-A223610; NCSC-TM-492-88) Avail: NTIS HC A03/MF A01 CSCL 20/4

A method for modeling the dynamics of towed cable systems is described. The cable system is assumed to be a multiple branched system with towed bodies. These bodies may be spheres or more general vehicles having a single plane of symmetry. The motion of the two points of the system is arbitrary. The cable is modeled by a series of rigid cylinders connected end-to-end by spherical joints. It is further assumed that the physical parameters of the system and the external forces acting on it can be lumped at the connecting joints. The towed vehicles are three-dimensional bodies with linear (about a steady-state configuration) time-domain analyses. Examples are used to illustrate the analyses. GRA

N90-29645# Illinois Univ., Urbana-Champaign. Decision and Control Lab.

ADAPTIVE CONTROL OF AN ARC WELDING PROCESS M.S. Thesis

Daniel Edward Henderson Jun. 1990 64 p
(Contract DACA88-90-0003)
(AD-A223626; UILU-ENG-90-2220; DC-119) Avail: NTIS HC A04/MF A01 CSCL 11/6

An adaptive system controlling weld puddle width is presented. It is based on the method of sensitivity points. The development of the general design is given. Simulated and experimental setup and results are presented. GRA

N90-29646# Royal Aircraft Establishment, Farnborough (England).

THE INVESTIGATION AND PRODUCTION OF TITANIUM-TANTALUM JUNCTIONS DIFFUSION BONDED AT HIGH TEMPERATURE (855 C TO 920 C): THE INFLUENCE OF TEMPERATURE, TIME PRESSURE AND ROUGHNESS ON THE MECHANICAL PROPERTIES, AND THE OPTIMISATION OF THE BONDED CONDITIONS

S. Pineau, M. Veyrac, M. Hourcade, and B. Hocheid Jan. 1990 36 p
(BR114894; RAE-Trans-2180) Avail: NTIS HC A03/MF A01

It is shown that, despite a clear Kirkendall effect, it is possible within the technical constraints to find a combination of the four main operating parameters (temperature, time, pressure, and roughness) which allows the successful diffusion bonding of titanium and tantalum (with fracture of the tensile test specimens occurring in the tantalum at 360 MPa). The optimum temperature range at low pressure (2 to 5 MPa) lies in the alpha phase of titanium at 875 to 885 C. The pressure, which plays a decisive role in the resorption kinetics of residual defects, must be greater than 2 MPa to ensure the production of strong and ductile junctions in a reasonable time. The application of a temporary overpressure during heating offers many advantages, such as limited deformation of test pieces, saving of time, the production of better quality junctions, and even the bonding of surfaces with significant roughness. Author

N90-29647# Oak Ridge National Lab., TN. Metals and Ceramincs Div.

SCALE EFFECTS IN STEADY-STATE FRICTION

P. J. Blau 1990 28 p Presented at the Joint STLE-ASME Tribology Conference, Toronto, Ontario, 7-10 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE90-012943; CONF-901071-5) Avail: NTIS HC A03/MF A01

Sliding friction phenomena have long been the subject of study and modeling. The physical portrayal of the sliding contact upon which such models are based is often a function of the modeler's background, and may range from the atomic scale to the scale of more macroscopic surface roughness. Sometimes, quasi-static arguments are inappropriately applied to sliding situations. The current paper examines the nature of frictional variations during sliding contact. High recording-rate instrumentation was used to analyze detailed, point-to-point variations in friction force for self-mated, pin-on-disk experiments with alumina and aluminum specimens. Data indicate that friction mechanisms, even on a fine scale, must be modeled considering the whole tribosystem, not just the interfacial materials properties alone. The contact conditions stimulate the displacements in the tribocomponents, which in turn result in sensible mechanical output. It is physically unrealistic to develop sliding solid friction models which predict only a single friction value, rather a range of values typical of the variation experienced by the dynamic tribosystem should be developed. A systems approach rather than a discrete asperity approach may ultimately prove to be must productive for modeling tribosystems of engineering interest. DOE

N90-29648# Department of Energy, Washington, DC.

QUICK-CONNECT COUPLER FOR REMOTE MANIPULATION Patent Application

James C. Dobbins, inventor (to DOE) (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls.) 27 Jul. 1989 18 p
(Contract DE-AC07-84ID-12435)
(DE90-015352; US-Patent-Appl-SN-385519; Patents-US-A7385519) Avail: NTIS HC A03/MF A01

An adaptor for a single-point attachment, push-to-connect/pull-to-disconnect, quick-connect fluid coupler which enables the coupler to be remotely manipulated is described. DOE

N90-29649# Oak Ridge National Lab., TN. Engineering Physics and Mathematics Div.

ROBOTS, SYSTEMS, AND FLEXIBLE AUTOMATION

M. Beckerman Aug. 1990 14 p
(Contract DE-AC05-84OR-21400)
(DE90-015802; ORNL/FTR-3690) Avail: NTIS HC A03/MF A01

The traveler attended three conferences. The first of these was the IEEE International Workshop on Intelligent Robots and Systems 1990, held in Tsuchiura, Japan. The traveler presented a paper entitled, Multi-Cnteria Position and Configuration Optimization for Redundant Platform/Manipulator Systems, on the behalf of the authors F. G. Pin and J. C. Culioli. The traveler chaired the session on Mobile Robot Control. The second conference attended was the 1990 Japan-USA Symposium on Flexible Automation, sponsored by the Institute of Systems, Control and Information Engineers (ISCIE) and the American Society of Mechanical Engineers (ASME). The traveler presented a paper entitled, Ultrasound and Visual Sensor Feedback and Fusion, authored by M. Beckerman, D. L. Barnett and S. M. Killough. DOE

N90-29650# National Aerospace Lab., Tokyo (Japan).

INVESTIGATION OF FLUID DYNAMIC PERFORMANCE OF LE-7 LIQUID OXYGEN PUMP

Hitoshi Yamada, Yoshiaki Watanabe, Makoto Yoshida, Satoshi Hasegawa, and Kenjiro Kamijo Apr. 1989 13 p In JAPANESE; ENGLISH summary
(NAL-TR-1020; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The development of a large launch vehicle (H-2) started in 1985. The first stage of the launch vehicle uses a liquid oxygen/hydrogen engine (LE-7), which generates 1,180 KN in thrust with a two-stage combustion cycle. The liquid oxygen turbopump consists of a main pump, a preburner pump and a single stage turbine. The design rotational speed is 20,000 rpm and the delivery pressure of the main pump is 20.3 MPa and that of the preburner pump is 31.7 MPa. The flow rate is 229.1 kg/s and NPSH is 30 m. These high rotational speed, large flow rate and low suction pressure require combination of a cavitating inducer and a main impeller. In order to design a high pressure delivery pump with a high pump efficiency, it is necessary to analyze the pump blade passage flows in detail, using a three dimensional flow analysis method. The initial design of the liquid oxygen pump of the LE-7 engine is described and also the results were presented for some experiments which were carried out using liquid oxygen and liquid nitrogen as the pump fluid, at the turbopump test facility of the National Aerospace Laboratory, Kakuda Branch. The predicted pump head coefficient was in reasonable agreement with the experimental results considering the pump efficiency. Furthermore, a method was developed which calculates blade shapes correctly, and it was very useful in analyzing flows in impeller blade passages. Author

N90-29651# National Aerospace Lab., Tokyo (Japan).
LUBRICATION CHARACTERISTICS OF ROLLING BEARINGS LUBRICATED BY SELF-LUBRICATING COMPOSITE RETAINERS. PART 1: SELECTION OF BEARINGS FOR EARTH SENSORS
Katsumi Seki, Yukio Miyakawa, and Makoto Nishimura Apr. 1989 13 p In JAPANESE; ENGLISH summary
(NAL-TR-1019; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

More than 90 percent of rolling bearings for space use are lubricated by solid lubricant films transferred from retainers to balls and races; successful operation of space driving mechanisms depends on the selection of retainer materials made of self-lubricating composites together with the selection of solid lubricant films deposited in advance on the surfaces of balls and races for the initial state of operation. The process and the results of the selection tests carried out for ball bearings used in the Earth sensors which were operated from February 1981 to April 1982 on the Engineering Test Satellite 4 are described. Among 8 candidate materials tested in the form of a retainer, the combination of sputtered MoS2 films and retainers composed of PTFE, glass fiber and molybdenum showed by far the best tribological response. When applied to angular-contact type ball bearings (7204), this combination lubricated them for more than 10,000 hours at 2,000 rpm under a thrust load of 50 N in 10(exp 6) Pa. The bearings actually used in flight were lubricated by PTFE coatings and retainers made from PTFE, glass fiber, and lead oxide for fear that an MoS2 film would be worn off during tests conducted on Earth before the launch. Test results indicated this particular combination is more effective in air than in vacuo. The addition of MoS2 to the composites did not improve their lubricating ability, suggesting that PTFE performs the main role in transfer film lubrication. Author

N90-29790*# Oak Ridge National Lab., TN.
TRACTION-DRIVE FORCE TRANSMISSION FOR TELEROBOTIC JOINTS
D. P. Kuban and D. M. Williams *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 103-115 Previously announced as N89-25461 (For primary document see N90-29780 24-54)
(MMES-40-1553-85)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29861*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
THE EFFECTS OF GEAR REDUCTION ON ROBOT DYNAMICS
J. Chen *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 297-307 (For primary document see N90-29830 24-54)
(Grant NAG5-1019)
Avail: NTIS HC A19/MF A03 CSCL 13I

N90-29892*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL TELEROBOTIC MANIPULATOR CONTROL AND MECHANIZATION (MCM) SUBSYSTEM
Samad Hayati, Thomas S. Lee, Kam Tso, Paul Backes, Edwin Kan, and J. Lloyd (McGill Univ., Montreal, Quebec) *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 173-182 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N90-29652# Department of Energy, Washington, DC.
NONDESTRUCTIVE MATERIAL CHARACTERIZATION Patent Application
Vance A. Deason, inventor (to DOE), John A. Johnson, inventor (to DOE), and Kenneth L. Telschow, inventor (to DOE) (Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.) 14 Jul. 1989 21 p
(Contract DE-AC07-76ID-01570)
(DE90-015176; US-Patent-Appl-SN-379832;
Patents-US-A7379832) Avail: NTIS HC A03/MF A01

A method and an apparatus for nondestructive material characterization, such as identification of material flaws or defects, material thickness or uniformity and material properties such as acoustic velocity are discussed. The apparatus comprises a pulsed laser used to excite a piezoelectric (PZ) transducer, which sends acoustic waves through an acoustic coupling medium to the test material. The acoustic wave is absorbed and thereafter reflected by the test material, whereupon it impinges on the PZ transducer. The PZ transducer converts the acoustic wave to electrical impulses, which are conveyed to a monitor. DOE

N90-29653# California Univ., Berkeley. Engineering Systems Research Center.
SYSTEMS RELIABILITY AND INFERENCE: SUMMARY OF ACCOMPLISHMENTS 1988-1990 Final Report, 1 Jun. 1986 - 30 Sep. 1989
William S. Jewell 30 Sep. 1989 10 p
(Grant AF-AFOSR-0208-86; AF Proj. 2304)
(AD-A224433; AFOSR-90-0778TR) Avail: NTIS HC A02/MF A01 CSCL 12/3

Research on systems reliability and inference were focussed on three major areas: linear approximations for estimating first and second moments for a variety of different models; delayed reporting models, with emphasis on predicting unreported counts generated over a fixed exposure interval; and generalized models of life testing with incomplete data. Some areas of discussion are as follows: Approximations for Bayesian Estimation and Prediction; Delayed Reporting Models; Life Testing with Incomplete Data. GRA

N90-29654# Army Combat Systems Test Activity (Provisional), Aberdeen Proving Ground, MD.
TECHNIQUES FOR DEVELOPING A SYSTEM SAFETY RISK ASSESSMENT MODEL Technical Report, Jan. 1987 - Feb. 1988

Martin Mossa and Thomas A. Lucas Apr. 1990 62 p
(AD-A223477; USACSTA-6962; TR-90-3) Avail: NTIS HC A04/MF A01 CSCL 13/12

A study was conducted by the U.S. Army Combat Systems Test Activity at Aberdeen Proving Ground, MD, to determine if existing data collected by that activity could be used to conduct a quantitative risk assessment. The results of this study indicate that the data are not only available but also in a usable form to conduct quantitative risk assessments. The results of the risk assessment will provide project managers with reasonable alternatives when considering designs, cost, and safety. GRA

N90-29655# Naval Underwater Systems Center, New London, CT. Dept. of Engineering and Technical Services.
PERFORMANCE MONITORING, FAULT DETECTION, FAULT LOCALIZATION DESIGN GUIDANCE Summary Report
Susanne B. Walsh 21 May 1990 64 p Sponsored by Naval Sea Systems Command, Washington, DC
(AD-A223619; NUSC-TR-8315A; NUSC-TR-8315) Avail: NTIS HC A04/MF A01 CSCL 12/6

This report is a formal approach to standardizing specifications and descriptions of performance monitoring, fault detection, fault localization (PM/FD/FL) for all disciplines, hardware, firmware, software, reliability, maintainability, configuration management, and integrated logistic support. GRA

N90-29656# Oak Ridge National Lab., TN.
NEURAL NETS AND EDDY-CURRENT TESTING
J. D. Allen, Jr., C. V. Dodd, J. R. Pate, and F. M. Schell 1990 8 p Presented at the Review of Progress in Quantitative NDE, La Jolla, CA, 15-20 Jul. 1990
(Contract DE-AC05-84OR-21400)
(DE90-016044; CONF-900791-1) Avail: NTIS HC A02/MF A01

Artificial neural networks of a novel type have been trained and tested on a variety of eddy-current flaw signals commonly occurring in nuclear reactor steam generators with the ultimate goal of emulating, at least crudely, the vision and reasoning capabilities of the human analyst. The network methodology itself was that of Allen and Schell, developed originally for studies of such biologically relevant neural properties as cognitive complementarity and concept formation. Because they are so important to the results obtained, we discuss the general characteristics of the approach in the Preamble. In Section 1 we describe the relevant aspects of the neural network configuration presently in use and in Section 2 the method by which the artificial neural systems have been trained. Finally, we discuss results of the training process for systems explored. DOE

N90-29657# National Aerospace Lab., Tokyo (Japan).
FRICTION, WEAR AND ELECTRIC CHARACTERISTICS OF SLIP-RING BRUSH MATERIALS FOR SPACE APPLICATIONS. PART 1: SCREENING BY PIN-ON-DISK FRICTION TESTS
Mineo Suzuki, Mikio Watanabe, Makoto Nishimura, and Mitsuhiro Harima Nov. 1989 46 p In JAPANESE; ENGLISH summary
(NAL-TR-1040; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Screening tests were carried out to find the optimum brush material of a slip-ring for space applications. Friction, wear and electric characteristics of three types of silver-based, hot-pressed composites were evaluated in a vacuum environment, using a dual-pin-on-disk friction tester. The composites were used as pin specimens and rubbed against a coin silver disk. Electric direct current of 1 A was transmitted from one pin to the other pin via the disk. The load and the sliding speed were 0.85 N and 158 mm/s, respectively, for one pin, and 0.5 N and 75 mm/s for the other pin. The number of repeated rubbings was 55,000 times. The results obtained were: the optimum concentration of solid lubricant was about 15 percent, the best performance was obtained with the compositions of Ag(85 percent) + MoS2 (15 percent), Ag(85 percent) + MoS2(7.5 percent) + NbSe2(7.5 percent), and Ag(90 percent) + MoS2(5 percent) + NbSe2(5 percent), and AgMoS2 composite gave the best result in terms of friction and electrical noise, while Ag-MoS2-NbSe2 composites showed the lowest wear and electrical contact resistance. As the second step of the study, the load imposed on the pin specimen was changed from 0.5 to 5 N. The increase in load resulted in better electrical performance and less wear. The decrease in wear was due to the smaller electrically induced wear, which seemed to result from better contact between the pin and the disk. It was found that a load of over 2 N was required to obtain good performance. The difference between spring loading and dead weight loading of the pin specimen was also examined. Author

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N90-29658 Nebraska Univ., Lincoln.
APPLICATION OF THE COMPLEX VARIABLE SOLUTION TO SOME PROBLEMS IN LINEAR ELASTIC MATERIALS WITH VOIDS Ph.D. Thesis
Deborah Joanne Wilson 1989 64 p
Avail: Univ. Microfilms Order No. DA9013637

The similarity between the temporal solution of the equations of the plane theory of linear elastic materials with voids and the equations of plan theory of thermoelasticity is noted. The complex variable solution is applied to an infinite plate which contains a circular hole and is subjected to a uniaxial tensile stress at infinity. A hollow cylinder subjected to internal and external pressure is also analyzed. Dissert. Abstr.

N90-29659 Virginia Polytechnic Inst. and State Univ., Blacksburg.
ON A GENERALIZED LAMINATE THEORY WITH APPLICATION TO BENDING, VIBRATION, AND DELAMINATION BUCKLING IN COMPOSITE LAMINATES Ph.D. Thesis
Ever J. Barbero 1989 307 p
Avail: Univ. Microfilms Order No. DA9013515

A computational model for accurate analysis of composite laminates and laminates with including delaminated interfaces is developed. An accurate prediction of stress distributions, including interlaminar stresses, is obtained by using the Generalized Laminate Plate Theory of Reddy in which layer-wide linear approximation of the displacements through the thickness is used. Analytical as well as finite-element solutions of the theory are developed for bending and vibrations of laminated composite plates for the linear theory. Geometrical nonlinearity, including buckling and postbuckling are included and used to perform stress analysis of laminated plates. A general two-dimensional theory of laminated cylindrical shells is also developed in this study. Geometrical nonlinearity and transverse compressibility are included. Delaminations between layers of composite plates are modelled by jump discontinuity conditions at the interfaces. The theory includes multiple delaminations through the thickness. Geometric nonlinearity is included to capture layer buckling. The strain energy release rate distribution along the boundary of delaminations is computed by an algorithm. The computational models presented herein are accurate for global behavior and particularly appropriate for the study of local effects. Dissert. Abstr.

N90-29660 Northwestern Univ., Evanston, IL.
INVESTIGATION OF THE DYNAMIC BUCKLING OF LIQUID-FILLED TANKS Ph.D. Thesis
Rasim Aziz Uras 1989 192 p
Avail: Univ. Microfilms Order No. DA9015417

The governing equations which consider dynamic fluid-structure interaction, modal coupling in both axial and circumferential directions, and dynamic buckling are derived. The various pressure components acting on the shell wall due to a seismic event are also analyzed. The matrix equation of motion for liquid-filled shells is obtained through a Galerkin/Finite Element discretization

procedure. The modal coupling among the various combinations of axial and circumferential modes are identified with a particular reference to the fluid-structure system under seismic excitation. The equations for the dynamic stability analysis of liquid-filled shells are presented. The effects of various types of ground motion of the dynamic stability of the fluid-structure system are analyzed. The stability criteria of liquid-filled shells subjected to horizontal and rocking excitation, shear loading, bending/shear combined loading, and vertically applied load are established. The resulting instability regions and stability charts are given in tables in omega-epsilon plots. Finally, the experimental results of dynamic stability characteristics of liquid-filled shells under horizontal excitation are compared with the theoretical results. The importance of modal interaction in the axial as well as circumferential directions becomes apparent. Especially, the coupling between the (n)th and (n+1)th circumferential modes is found to be the major cause for the instability of fluid-structure systems under horizontally applied ground motion. Dissert. Abstr.

N90-29661# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
RESEARCH INTO TRAVELING WAVE CONTROL IN FLEXIBLE STRUCTURES Final Report, 1 Nov. 1988 - 28 Feb. 1990
Andreas H. VonFlotow 15 Jun. 1990 180 p
(Grant AF-AFOSR-0029-88; AF Proj. 2302)
(AD-A224504; AFOSR-90-0837TR) Avail: NTIS HC A09/MF A01 CSCL 20/11

This report summarizes 16 months of research into active control of elastic wave propagation in flexible structures. The report format is that of a brief executive summary supported by an extensive appendix containing the research publications generated in the course of this research. The research performed can be broken into two major fields: broadband damping by impedance matching the control system to the underlying wave (or dereverberated) impedance of a flexible structure; and sensor development for purposes of wave observation and control. GRA

N90-29662# Technical Research Centre of Finland, Espoo.
THE ACR-PROGRAM FOR AUTOMATIC FINITE ELEMENT MODEL GENERATION FOR PART THROUGH CRACKS
M. S. Leinonen and T. P. J. Mikkola 1989 81 p
(DE90-631545; VTT-TUTK-658) Avail: NTIS (US Sales Only) HC A05/MF A01

The ACR-program (Automatic Finite Element Model Generation for Part Through Cracks) has been developed at the Technical Research Center of Finland (VTT) for automatic finite element model generation for surface flaws using three dimensional solid elements. Circumferential or axial cracks can be generated on the inner or outer surface of a cylindrical or toroidal geometry. Several crack forms are available including the standard semi-elliptical surface crack. The program can be used in the development of automated systems for fracture mechanical analyses of structures. The tests for the accuracy of the FE-mesh have been started with two-dimensional models. The results indicate that the accuracy of the standard mesh is sufficient for practical analyses. Refinement of the standard mesh is needed in analyses with high load levels well over the limit load of the structure. DOE

N90-29663# Army Lab. Command, Watertown, MA. Materials Dynamics Branch.
THE MTL TORSIONAL SPLIT-HOPKINSON BAR Final Report
Tusit Weerasooriya May 1990 35 p
(AD-A223278; MTL-TR-90-27) Avail: NTIS HC A03/MF A01 CSCL 14/2

A Siored Torque Split-Torsional Hopkinson bar (THBar) was developed (based on the principle of the one located at Brown University) and constructed at the U.S. Army Material Technology Laboratory (MTL). This report provides a detailed description of the THBar and its shear, axial and bending characteristics, and use of it to generate high strain rate shear stress-strain data of annealed oxygen-free, high conductivity (OFHC) copper (99.99 percent copper). With the present clamp of the THBar, shear stress-strain data can be generated for strain rates from 200 to 1300 s-1. At the highest strain rate, a specimen can be deformed in shear to a maximum strain of 85 percent with the shear pulse of 655 micro seconds. Three tests have been conducted for copper at strain rates of 400, 800, and 1200 s-1. The shear stress-strain curves that have been generated at these three strain rates show a strain rate sensitivity for strains less than 35 percent; stress increases with strain rate for a constant strain. At higher strain rates and higher strains (greater than 35 percent strains), shear stress saturates to a constant value independent of the strain rate. High strain rate, shear stress-strain data correlate favorably with the trend found in the quasi-static rate data from a servohydraulic test machine. GRA

N90-29664# Wright Research Development Center, Wright-Patterson AFB, OH.
PROCEEDINGS OF DAMPING '89. VOLUME 1: PAGES AAB-1 THROUGH DCD-11 Final Report, Feb. 1986 - Feb. 1989
Nov. 1989 511 p Proceedings held in West Palm Beach, FL, 8-10 Feb. 1989
(AF Proj. 486U)
(AD-A223431; WRDC-TR-89-3116-Vol-1) Avail: NTIS HC A22/MF A03 CSCL 20/11

Session topics in this volume include: complex modules; aircraft applications; composite materials/structures; electro-rheological fluids; hydraulic dampers; damping identification and analysis; fractional derivatives; and space applications. GRA

N90-29665# Wright Research Development Center, Wright-Patterson AFB, OH.
PROCEEDINGS OF DAMPING '89. VOLUME 2: PAGES FAA-1 THROUGH IBD-15 Final Report, Feb. 1986 - Feb. 1989
Nov. 1989 694 p Proceedings held in West Palm Beach, FL, 8-10 Feb. 1989
(AF Proj. 486U)
(AD-A223432; WRDC-TR-89-3116-Vol-2) Avail: NTIS HC A99/MF A04 CSCL 20/11

Individual papers of Damping 89 are presented. The subjects include: mechanical properties of polymers, experimental methods, damping in metal matrix composites, friction damping, design of damping structure, modal damping values, and applications of damping. Session topics included in this volume are: complex modulus data; structural applications; control structure interactions; nonlinear systems; fluids/friction; struts; phenomena; large space structures; joints; viscous dampers; optimization; and aircraft experiments. GRA

N90-29666# Wright Research Development Center, Wright-Patterson AFB, OH.
PROCEEDINGS OF DAMPING '89. VOLUME 3: PAGES ICA-1 THROUGH KDC-15 Final Report, Feb. 1986 - Feb. 1989
Nov. 1989 608 p Proceedings held in West Palm Beach, FL, 8-10 Feb. 1989
(AF Proj. 486U)
(AD-A223433; WRDC-TR-89-3116-Vol-3) Avail: NTIS HC A99/MF A04 CSCL 20/11

Session topics in this volume include: vibration suppression; free layer damping; laminates; launching; model verification; metals; sandwich construction; impact damping; and space applications. GRA

N90-29667# Dayton Univ., OH. Aerospace Mechanics Div.
EVALUATION OF PLANE-OF-LIGHT NONINTERFERENCE STRESS MEASUREMENT SYSTEMS FOR MEASURING BLADED DISK VIBRATIONS Interim Report, Sep. 1987 - Aug. 1988
Midturi Swaminadham and Robert J. Dominic 24 Dec. 1989 121 p
(Contract F33615-85-C-2585; AF Proj. 3066)
(AD-A223487; UDR-TR-89-18; WRDC-TR-89-2125) Avail: NTIS HC A06/MF A01 CSCL 20/11

Techniques are described for the measurement of

traveling-mode vibrations of rotating bladed disks using a nonintrusive optical instrumentation system. This system incorporates a circumferentially-mounted plane-of-light sensor to detect time of arrival of blades on a rotating disk. These time of arrivals are compared to a 1-per-rev signal to determine the amount of relative displacements. This displacement is fed into a model-generating algorithm to determine frequencies of vibration; and mode shape. This system was compared to a separate noncontacting system to compare their measuring capability and accuracy. GRA

N90-29668# Pennsylvania State Univ., University Park. Materials Research Lab.

PIEZOELECTRIC AND ELECTROSTRICTIVE MATERIALS FOR TRANSDUCER APPLICATIONS, VOLUME 1 Annual Report, 1 Feb. 1989 - 31 Jan. 1990

L. E. Cross, R. E. Newnham, A. S. Bhalla, J. P. Dougherty, J. H. Adair, V. K. Varadan, and V. V. Varadan 31 Jan. 1990 256 p
(Contract N00014-89-J-1689)
(AD-A223560) Avail: NTIS HC A12/MF A02 CSCL 20/11

Studies of the 3:0 type composite have evolved a new structure for a much more effective stress transforming composite. The device uses cavities in the electrode structure which are simple, inexpensive and robust. The sensitivity is higher than that of the end capped cylinder for equivalent PZT volume and it is believed that this will be a most important development for towed array hydrophones. For agile transducer structures, the very high piezoelectric coefficients induced by dc bias in the lead magnesium niobate:lead titanate electrostrictors were confirmed using both resonance and ultra-dilatometer methods. In parallel studies of aging in these systems a rather complete understanding of the aging process was obtained and methods for fabricating PMN:PT systems with no aging developed, an essential need for the agile transducer. The phenomenology of the PZT system was completed and the equations are now being applied to studies of the properties of PZT compositions at the lead titanate end of the system. The phenomenology will be particularly valuable for the future evaluation of thin film PZTs where the breakdown field are such that EB.Ps is a large perturbation to the total energy. In high strain actuators for surface modification and flow control antiferroelectric:ferroelectric systems were explored which yield strains up to 0.85 percent. GRA

N90-29669# Pennsylvania State Univ., University Park. Materials Research Lab.

PIEZOELECTRIC AND ELECTROSTRICTIVE MATERIALS FOR TRANSDUCER APPLICATIONS, VOLUME 2 Annual Report, 1 Feb. 1989 - 31 Jan. 1990

L. E. Cross, R. E. Newnham, A. S. Bhalla, J. P. Dougherty, J. H. Adair, V. K. Varadan, and V. V. Varadan 31 Jan. 1990 966 p
(Contract N00014-89-J-1689)
(AD-A223561) Avail: NTIS HC A99/MF E06 CSCL 20/11

Some areas of study are as follow: Thermodynamic Theory of PbZrO3; Thermodynamic Theory of the Lead Zirconate-Titanate Solid Solution System; Part I. Phenomenlogy; Part II. Tricritical Behavior; Part III. Curie Constant and Sixth Order Polarization Interaction Dielectric Stiffness Coefficients; Part IV. Tilting of the Oxygen Octahedra; Part V. Theoretical Calculations; Electrostrictive Properties of the Lead Zirconate-Titanate Solid Solution System; Modeling of the Electrostrictive, Dielectric and Piezoelectrics Properties of Ceramic PbTiO3; Ferroelectric Properties of Tungsten Bronze Morphotropic Phase Boundary Systems; A Thermodynamic Phenomenology for Ferroelectric Tungsten Bronze Sr(0.6)Ba(0.4)Nb2O6 (SBN60); Composition and Temperature Dependence of the Dielectric, Piezoelectric and Elastic Properties of Pure PZT Ceramics; Sol-Gel Processing of Lead Titanate in Two Methoxyethanol Investigation into the Nature of the Prehydrolized Solutions; Field Forces Antiferroelectrics to Ferroelectric Switching in Modified Lead Zirconate Titanate Stannate Ceramics; Transition Speed on Switching From a Field Induced Ferroelectric State to an Antiferroelectric Upon the Release of the Applied Field in (PbLa)(ZrTiSn)O3 Antiferroelectric Ceramics; Design and Analysis of the Performance of PZT/Polymer Composite Transducers; Finite Element-Eigenmode Analysis for the Design of 1-3 Composite Transducers Including the Effect of Fluid Loading. GRA

N90-29670# Harvard Univ., Cambridge, MA. Div. of Applied Sciences.

STUDIES ON CRACK MECHANICS Final Report, 1 Jun. 1985 - 30 Nov. 1989

James R. Rice and Gordon McKay 21 Jun. 1990 24 p
(Contract N00014-85-K-0405)
(AD-A223634) Avail: NTIS HC A03/MF A01 CSCL 20/11

Theoretical studies were done on crack tip stress and deformation fields based on continuum plasticity for single crystals. Asymptotic analysis was carried out for ideally plastic single crystals for both stationary and moving cracks under anti-plane shear and mode I plane strain conditions. They show that in the near tip region the plastic flow is confined primarily to planes along which both the stresses and the displacements are discontinuous for stationary cracks, or the velocity is discontinuous for quasi-statically growing cracks. These planes may be parallel or perpendicular to the traces of the slip planes which are locally stressed to yield levels and provide the plastic straining. The inclusion of strain hardening, as studied so far based on power hardening with resultant Hutchinson, Rice, and Rosengren (HRR) fields, removes these discontinuities in the case of the stationary crack, although small angular ranges of very rapid stress variation result instead when there is only moderate strain hardening. In the ideally plastic limit however, these HRR fields yield a continuous displacement field, while resulting in the correct stress discontinuities. Thus, it is conjectured that the domain of validity of the HRR field must shrink as the ideally plastic limit is approached. Furthermore, this domain is expected to be confined to only part of the plastic zone immediately adjacent to the crack tip. Studies are now underway to check these conjectures. GRA

N90-29671# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

A VECTOR DIAGRAM APPROACH TO SHAPING INPUTS FOR VIBRATION REDUCTION

William Singhose Mar. 1990 54 p
(Contracts N00014-86-K-01685; DL-H-404169)
(AD-A223724; AI-M-1223) Avail: NTIS HC A04/MF A01 CSCL 20/11

This paper describes a method for limiting vibration in flexible systems by shaping the system inputs. Unlike most previous attempts at input shaping, this method does not require an extensive system model or lengthy numerical computation; only knowledge of the system natural frequency and damping ratio are required. The effectiveness of this method when there are errors in the system model is explored and quantified. An algorithm is presented which, given an upper bound on acceptable residual vibration amplitude, determines a shaping strategy that is insensitive to errors in the estimated natural frequency. A procedure for shaping inputs to systems with input constraints is outlined. The input shaping method is evaluated by dynamic simulations and hardware experiments. GRA

N90-29672# Oak Ridge National Lab., TN.

AN INVESTIGATION OF CRACK-TIP STRESS FIELD CRITERIA FOR PREDICTING CLEAVAGE-CRACK INITIATION

J. Keeney-Walker, B. R. Bass, and J. D. Landes (Tennessee Univ., Knoxville.) 1990 42 p Presented at the 22d National Symposium on Fracture Mechanics, Atlanta, GA, 26-28 Jun. 1990
(Contracts DE-AC05-84OR-21400; NRC-1886-8011-93)
(DE90-015597; CONF-900610-1) Avail: NTIS HC A03/MF A01

Cleavage crack initiation in large-sale wide-plate (WP) specimens could not be accurately predicted from small compact (CT) specimens utilizing a linear elastic fracture mechanics, K(sub Ic), methodology. In the wide-plate tests conducted by the Heavy-Section Steel Technology Program at Oak Ridge National Laboratory, crack initiation has consistently occurred at stress intensity (K(sub I)) values ranging from two to four times those predicted by the CT specimens. Studies were initiated to develop

crack-tip stress field criteria incorporating effects of geometry, size, and constraint that will lead to improve predictions of cleavage initiation in WP specimens from CT specimens. The work centers around nonlinear 2-D and 3-D finite-element analyses of the crack-tip stress fields in these geometries. Analyses were conducted on CT and WP specimens for which cleavage initiation fracture had been measured in laboratory tests. The local crack-tip field generated for these specimens were then used in the evaluation of fracture correlation parameters to augment the K(sub I) parameter for predicting cleavage initiation. Parameters of hydrostatic constraint and of maximum principal stress, measured volumetrically, are included in these evaluations. The results suggest that the cleavage initiation process can be correlated with the local crack-tip fields via a maximum principal stress criterion based on achieving a critical area within a critical stress contour. This criterion has been successfully applied to correlate cleavage initiation in 2T-CT and WP specimen geometries. DOE

N90-29673# Sandia National Labs., Albuquerque, NM. Applied Mechanics Div.

A VISCOELASTIC MATERIAL MODEL FOR COMPUTING STRESSES IN GLASS

Robert S. Chambers Jul. 1990 70 p

(Contract DE-AC04-76DP-00789)

(DE90-014851; SAND-90-0645) Avail: NTIS HC A04/MF A01

Glass-to-metal seals are an integral part of many electronic components. When seals are formed at elevated temperatures and cooled to room temperature, residual stresses are generated by the unequal thermal contractions of the constituent materials. The combination of high stress and low fracture resistance of glass makes it extremely difficult to design and build hermetic glass-to-metal seals. Rigorous and robust stress analyses must incorporate the complex and coupled changes in volumetric strain and stress relaxation which occur as glass passes through the liquid/solid temperature regime. The phenomenological behavior of glass can be modeled viscoelastically. The theory and numerical discretization of the viscoelastic equations is presented for use in finite element programs. Vectorizable integration schemes are derived for both the traditional hereditary integrals of viscoelasticity and the equivalent rate forms of the equations. The general behavior of glass is discussed and related to the viscoelastic model. Solutions to discretized viscoelastic equations are applied to an example problem and compared to results obtained from experimental data. The viscoelastic model of glass provides a new capability to analyze and design actual manufacturing processes by predicting, a priori, the effects of temperature history on the residual stress state. DOE

N90-29674# Oak Ridge National Lab., TN.

ACCURATE CALCULATIONS OF NEUTRON KERMA AND DAMAGE FROM ENDF/B-VI EVALUATIONS FOR SILICON, CHROMIUM, IRON AND NICKEL, AND COMPARISON WITH ENDF/B-V RESULTS

D. C. Larson, D. M. Hetrick, C. Y. Fu, S. J. Epperson, and R. E. MacFarlane 1990 11 p Presented at the 7th ASTM-EURATOM Symposium on Reactor Dosimetry, Strasbourg, France, 27-31 Aug. 1990

(Contract DE-AC05-84OR-21400)

(DE90-016020; CONF-900814-7) Avail: NTIS HC A03/MF A01

Accurate calculations of kerma (Kinetic Energy Released in MAterials) factors and displacement cross sections are fundamental to studies of neutron heating and neutron radiation damage. Damage and heating studies are important elements in both fission and fusion reactor design. For fusion reactor studies, heating in the blanket helps determine the efficiency, and heating studies in the superconducting magnet regions determine properties of the blanket and shield, thereby affecting the economics of the reactor. Radiation damage is important for reactor core lifetime studies and is related directly to the economy and safety of both fusion and fission reactors. Calculation of kerma factors and displacement cross sections require nuclear data for neutron-induced reactions. These data are normally obtained from evaluated nuclear data libraries, such as ENDF/B (US), JENDL (Japan), JEF/EFF (Europe) and BROND (USSR). Unfortunately, most of these evaluated libraries do not contain sufficient information for a direct calculation of these quantities, and various approximations must be employed. The accuracy of the kerma factors and displacement cross sections, and thus the heating and damage functions, are directly related to the available information from the data libraries. In this paper we describe improvements incorporated in the latest version of the U.S. library, ENDF/B-VI, which allow exact calculations of these quantities for many of the structural materials included in the library. DOE

N90-29675# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.

COMPARISON OF CRACK CLOSURE RESULT OBTAINED BY 3D ELASTIC-PLASTIC FEM AND MODIFIED DUGDALE MODEL

A. F. Blom, G. S. Wang, and R. G. Chermahini 20 Mar. 1990 19 p Presented at the 1st International Conference on Computer Aided Assessment and Control of Localized Damage, Portsmouth, England, 26-28 Jun. 1990 Sponsored in part by the Swedish Board for Technical Development

(Contract FMV-82250-88-033-24-001)

(FFA-TN-1990-18; ETN-90-97513) Avail: NTIS HC A03/MF A01

Numerical predictions of crack opening stresses in a center cracked tension specimen, under constant amplitude loading conditions, were performed both with a three-dimensional elastic-plastic finite element procedure and with a Modified Dugdale Model (MDM). Elastic-perfectly plastic conditions were assumed and cyclic loading was kept at R = sigma (min)/sigma (max) = 0.1. The results show that the MDM derived for plane stress conditions, gives a good prediction of crack opening stress levels in the mid-plane of the test specimen when Irwin's plane strain constraint factor alpha = 1.73 is introduced in the model. Futhermore, crack surface displacements and residual stress distributions, in the specimen mid-plane, are in reasonable agreement between FEM (Finite Element Method) and MDM, when the plane strain constraint factor is used. ESA

N90-29676# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Regelung.

ACTIVE VIBRATION DAMPING OF FLEXIBLE STRUCTURES Ph.D. Thesis - Karlsruhe Univ.

Johann Bals 1990 179 p In GERMAN; ENGLISH summary

(DLR-FB-90-03; ISSN-0171-1342; ETN-90-97542) Avail: NTIS HC A09/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Rep. of Germany, HC 58 deutsche marks

Active vibration damping is required in case of disturbances like eigen oscillations. The problem can be subdivided into sensor actuator positioning, order reduction and controller design. The influence of the positioning of sensors and actuators on the modal order reduction and the pole sensitivity was investigated by using the dominance measures of Litz. To decide where sensors and actuators should be placed, positioning measures were introduced, which allow computer aided research for suitable positioning. The eigen values and the physical state variables of the model with reduced order were selected by using the Litz approach. An algorithm for an automatic state variable selection was developed to obtain a eigenvector matrix with condition number as low as possible. A stability robust control design was necessary because of uncertain model parameters. The active vibration damping concept was successfully applied to a generic structure. ESA

N90-29677# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Div. Resistance Fatigue.

A METHOD FOR MODELING KINEMATIC HARDENING AND CYCLIC STRAIN EFFECTS Final Report [PROPOSITION D'UN NOUVEAU FORMALISME POUR MODELISER L'ECROUISSAGE CINEMATIQUE ET LES EFFETS DE ROCHET, RAPPORT FINAL]

J. L. Chaboche May 1989 67 p In FRENCH

(Contract DRET-88-34-001)

(ONERA-RT-77/1765-RY-089-R; ETN-90-97563) Avail: NTIS HC A04/MF A01

A method for describing the progressive cyclic strain effects and maximal stress memorization is described. A new kinematic hardening law is proposed. Discrete memory schemes, which give the complete Masing rule, are used. The geometrical formulation of the model is based on a multiple surface structure proposed by Mroz. The isotropic hardening and the cyclic strain effects are defined independently. ESA

N90-29678# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

BUCKLING OF ANISOTROPIC CYLINDRICAL SHELLS SUBJECTED TO COMBINED AXIAL COMPRESSION, NORMAL PRESSURE, BENDING AND SHEAR LOADING

H. A. J. Knops Dec. 1989 131 p

(LR-611; ETN-90-97633) Avail: NTIS HC A07/MF A01

The stability behavior of anisotropic cylindrical shells subjected to compressive stresses is addressed. Previous study covered stability behavior of orthotropic cylinders. An analytical derivation of the stability matrix is performed. This stability matrix is used to calculate the critical buckling load of a perfect cylinder. Computer programs are developed to calculate the critical buckling load. In order to explain the working of this software and to illustrate some problems and their solution, a numerical calculation is performed for an anisotropic cylinder. ESA

N90-29679# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

AN INVESTIGATION OF HOLE-EDGE CRACK PROBLEM BY A COMBINED COMPLEX VARIABLE AND LEAST SQUARE METHOD

Junbiao Lai, J. Schijve, and Xing Zhang (Beijing Inst. of Aeronautics and Astronautics, China) Apr. 1990 48 p

(LR-626; ETN-90-97637) Avail: NTIS HC A03/MF A01

A full field solution for a region weakened by a hole with a pair of cracks of different lengths emanating from the hole edge is developed. Based upon Muskhelishvili's complex variable method, the solution is constructed in terms of stress functions in such a way that all the basic equations and the single value condition of displacements within the region, and the traction free condition on crack surfaces are satisfied exactly. The remaining boundary conditions are satisfied approximately by using the least square method in a boundary integral form. Calculations of K-values are made for a pair of cracks of different lengths and a single hole-edge crack in both infinite and finite plates. Information on the stress concentration (peak stress at the hole edge opposite to the single edge crack) is included. ESA

N90-29680# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

FRACTOGRAPHIC ANALYSIS OF FATIGUE CRACK GROWTH UNDER TWO-BLOCKS LOADING ON 2024-T351 SHEET SPECIMENS

M. R. Ling and J. Schijve Apr. 1990 25 p

(LR-628; ETN-90-97639) Avail: NTIS HC A03/MF A01

Fatigue crack growth in 2024-T351 sheet material (6.35 mm) under load sequences with periodic overload blocks are analyzed nearly cycle by cycle in the electron microscope. The purpose is to study the interaction effects between the load cycles with different amplitudes. The crack increment of the first overload cycle in an overload block is significantly larger (giant striation) than that of the direct following overload cycles and it increases systematically with the number of the small amplitude cycle applied before the overload block. It is probably a result of more primary plastic deformation around the crack tip. The crack growth situation after the first overload becomes approximately the same as in constant amplitude tests. The crack growth in the small amplitude blocks are retarded immediately after applying the overloads. The crack growth rates decrease subsequently (delayed retardation) to a minimum value following a similar trend. ESA

N90-29681# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

EFFECTS OF BLOCKS OF OVERLOADS AND UNDERLOADS ON FATIGUE CRACK GROWTH IN 2024-T351 SHEET SPECIMENS: FRACTOGRAPHIC ANALYSIS AND CRACK CLOSURE PREDICTIONS

M. R. Ling and J. Schijve Apr. 1990 27 p

(LR-629; ETN-90-97640) Avail: NTIS HC A03/MF A01

Fatigue crack growth in 2024-T351 sheet material under load sequences with underload-overload combinations is analyzed nearly cycle by cycle in the electron microscope. The purpose is to study the interaction effects between underloads, overloads and load cycles with a smaller amplitude. The overload block causes significant crack growth retardation in both the underload block and the small amplitude block as expected in view of the crack closure concept. The extent of the retardation in the small cycles reduces after applying underloads which is supposed to erase the retardation completely according to the crack closure concept. However, some retardation is still found. In the overload block itself only the first cycle shows a significantly larger crack increment. It is probably a result of more primary plastic deformation around the crack tip and a lower strain hardening level. The other overload cycles induce crack increments similar to those in constant amplitude tests, independent of the underload level. ESA

N90-29682# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

FATIGUE, STATIC TENSILE STRENGTH AND STRESS CORROSION OF AIRCRAFT MATERIALS AND STRUCTURES. PART 1: TEXT

J. Schijve Mar. 1990 229 p Revised

(LR-630-Pt-1-Rev; ETN-90-97641) Avail: NTIS HC A11/MF A02

A book used as a text for an aircraft materials course is presented. Stress concentrations, the stress intensity at crack tips, and residual stresses are discussed. Knowledge about these subjects is essential for further discussion on static tensile strength, stress corrosion and fatigue. Failure in tension is addressed, covering the material tensile strength, the blunt notch strength (strength of notched elements), fracture toughness and the residual strength of cracked parts. Aspects of stress corrosion are discussed. The main emphasis is on fatigue of materials and structures. The fatigue life is divided in two periods: the crack initiation period and the crack growth period. The significance of the two periods for practical problems is emphasized and used in the discussion of several effects on fatigue. Fatigue under constant-amplitude loading, fatigue under variable-amplitude loading, fatigue of joints, fatigue loads on aircraft structures and fatigue of aircraft structures, are presented. ESA

N90-29683# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.

FATIGUE, STATIC TENSILE STRENGTH AND STRESS CORROSION OF AIRCRAFT MATERIALS AND STRUCTURES. PART 2: FIGURES

J. Schijve Mar. 1990 121 p

(LR-630-Pt-2; ETN-90-97642) Avail: NTIS HC A06/MF A01

A book used as a text for an aircraft materials course is presented. Stress concentrations, the stress intensity at crack tips, and residual stresses are discussed. Knowledge about these subjects is essential for further discussion on static tensile strength, stress corrosion and fatigue. Failure in tension is addressed, covering the material tensile strength, the blunt notch strength (strength of notch elements), fracture toughness and the residual strength of cracked parts. Aspects of stress corrosion are discussed. The main emphasis is on fatigue of materials and structures. The fatigue life is divided in two periods: the crack initiation period and the crack growth period. The significance of the two periods for practical problems is emphasized and used in the discussion of several effects on fatigue. Fatigue under constant-amplitude loading, fatigue under variable-amplitude loading, fatigue of joints, fatigue loads on aircraft structures and fatigue of aircraft structures, are presented separately. ESA

N90-29684# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
FRACTOGRAPHIC OBSERVATIONS ON FATIGUE CRACK GROWTH UNDER MINITWIST FLIGHT-SIMULATION LOADING (2024-T3 MATERIAL)
J. Siegl (Technical Univ. of Prague, Czechoslovakia) and J. Schijve May 1990 65 p
(LR-631; ETN-90-97643) Avail: NTIS HC A04/MF A01

Fractographic observations were performed to determine fatigue crack growth increments corresponding to the most severe flights of the miniTWIST flight simulation. Specimens were tested under two miniTWIST load histories and three special load sequences based on the most severe flights of the miniTWIST. Bands caused by the severe flights could be distinguished on the fracture surface and an accurate reconstitution of the crack growth curve could be made. Crack increments occurring in the most severe flights were measured and compared with values predicted by the modified CORPUS model. Observations on accelerations and retardations are presented. ESA

N90-29685# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
RECENT DEVELOPMENTS IN SHELL STABILITY ANALYSIS
J. Arbocz and J. M. A. M. Hol May 1990 32 p Presented at the 11th US National Congress of Applied Mechanics, Tucson, AZ, 21-25 May 1990
(LR-633; ETN-90-97644) Avail: NTIS HC A03/MF A01

Recent studies are directed towards the development of improved shell design criteria, which incorporate the latest theoretical findings and make efficient use of the currently available computational facilities. The establishment of an international imperfection data bank is discussed. Characteristic initial imperfection distributions associated with different fabrication techniques are shown. Using the first order, second moment analysis, a stochastic method is presented, whereby the stability of isotropic, orthotropic and anisotropic nominally circular cylindrical shells under axial compression, external pressure and/or torsion possessing general nonsymmetric random initial imperfections can be evaluated. Results of measurements of initial imperfections are represented in Fourier series and the Fourier coefficients are used to construct the second order statistical properties needed. The computation of the buckling loads is done with the computer codes SRA and STAGS and include a rigorous satisfaction of the experimental boundary conditions. The proposed stochastic approach is shown to provide a means to combine the latest theoretical findings with the practical experiences spanning about 75 years in an optimal manner via the advanced computational facilities currently available. ESA

N90-29686# National Aerospace Lab., Tokyo (Japan).
FRACTOGRAPHIC ANALYSIS OF FATIGUE FAILURES OF AIRFRAME EQUIPMENT PARTS: EXAMPLES OF A ROD END HOUSING AND A ROD END CAP
Yoshiaki Kakuta and Toshiyuki Shimokawa Dec. 1989 14 p In JAPANESE; ENGLISH summary
(NAL-TR-1047; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Fatigue failure surfaces of a rod end housing and a rod end cap of airframe equipment used in transport airplanes were observed by a scanning electron microscope (SEM). Obtained fractographs were analyzed and fatigue crack initiation and propagation periods were estimated. Basic technical data were provided to determine proper inspection and replacement periods and intervals for the identical parts potentially fatigue damaged. The inspection and replacement periods and intervals for these parts were discussed. Author

N90-29687# National Aerospace Lab., Tokyo (Japan).
NONCONTACT MEASUREMENT OF ROTATING BLADE VIBRATIONS
Yukio Matsuda, Masanori Endoh, Nanahisa Sugiyama, and Takeshi Koshinuma Aug. 1989 51 p In JAPANESE; ENGLISH summary
(NAL-TR-1033; ISSN-0389-4010) Avail: NTIS HC A04/MF A01

A new noncontact measuring system for rotating blades vibrations of fans, compressors, and turbines was developed and successfully applied in the research and development project of turbofan engines and industrial gas turbines. It is a powerful measurement system which can simultaneously measure the vibration of all blades without the need of such processing of blades and rotor as in traditional strain gage measurement. The system consists of optical fiber blade-tip detectors on the peripheral of the engine casing, signal processing/data acquisition subsystem and control/calculation/display subsystem. Software is devised to insure valid data and high handling qualities of the system. Results of measurement are displayed on a sub-realtime basis in the on-line monitoring mode as vibration wave forms of a few blades and bar-graphs for the maximum vibration amplitudes of all the blades. Also an off-line data processing mode is available for later analysis and review. The measuring principle, the system performance, and the hard- and software, and in addition, some results of application and calibration which show good agreement with those of strain gage measurement, are described. Author

42 GEOSCIENCES (GENERAL)

N90-29688# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: EARTH SCIENCES
13 Mar. 1990 28 p
(JPRS-UES-90-004) Avail: NTIS HC A03/MF A01

Abstracts of Soviet literature in various areas of the life sciences are compiled. The following subject areas are covered: geology, oceanography, atmospheric physics, and ecology. M.G.

N90-29689# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: EARTH SCIENCES
23 Feb. 1990 25 p
(JPRS-UES-90-003) Avail: NTIS HC A03/MF A01

Abstracts of Soviet literature in various areas of the life sciences are compiled. The following subject areas are covered: geology, oceanography, and atmospheric physics. M.G.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N90-29690*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
RESULTS FROM ALOUETTE 1, EXPLORER 20, ALOUETTE 2, AND EXPLORER 31
John E. Jackson Jul. 1988 132 p
(NASA-TM-101822; NSSDC/WDC-A-R/S-88-10; NAS 1.15:101822) Avail: NTIS HC A07/MF A01 CSCL 08B

This is a continuation of the Alouette-Isis Program Summary of 1986. Not only included is a description of the objectives, spacecraft, experiments, and flight performance, but also a complete experiment related bibliography along with a comprehensive assessment of the technological and scientific accomplishments. The scientific results are presented from the first four of the six spacecraft of the Alouette-Isis program. E.R.

N90-29691# Geological Survey, Reston, VA.
SATELLITE IMAGE ATLAS OF GLACIERS OF THE WORLD: IRIAN JAYA, INDONESIA, AND NEW ZEALAND
Richard S. Williams, Jr., ed. and Jane G. Ferrigno, ed. 1989 59 p

(PB90-230095; USGS-PP-1386-H-1) Avail: NTIS HC A04/MF A01 CSCL 08B

Three small perennial ice fields with a total area of about 7.5 plus or minus 0.5 sq km are situated on Puncak Jaya massif, Puncak Mandala, and Ngga Pilimsit in the Central Range of Irian Jaya. The largest of these is the one on Puncak Jayaf massif with an area of about 7 sq km. The other ice fields each have a diameter of only several hundred meters. All the ice fields have experienced extensive and rapid retreat during this century. LANDSAT imagery has been used in conjunction with field measurements to locate, describe, and monitor changes in the ice fields. New Zealand is also discussed. Glaciers occur on the North Island on Mount Ruapehu and on the South Island along the crest of the Southern Alps from the Spenser Mountains in the north to southern Fiordland in the south. New Zealand has a humid maritime climate. The prevailing westerly winds bring 3000 mm of annual precipitation to the western coastal plains, 15,000 mm to just west of the main divide, and 1,000 mm to the eastern ranges. Easterly and southerly winds are important sources of snow east of the main divide. A comprehensive glacier inventory has just been completed. Author

N90-29692# European Space Agency, Paris (France).
THE SIGNALS OF AN ICE WARNING DEVICE IN DEPENDENCE ON TOTAL WATER CONTENT AND NORMALIZED ICING DEGREE
Hans-Eberhard Hoffmann, Johann Demmel, and Joachim Schuster (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) Jun. 1990 64 p Transl. into ENGLISH of Die Signale eines Eiswarngebers in Abhaengigkeit vom Gesamtwassergehalt in Wolken und vom normierten Vereisungsgrad Original report in GERMAN previously announced as ETN-90-96279
(ESA-TT-1207; DFVLR-FB-89-52; ETN-90-97598) Avail: NTIS HC A04/MF A01

The equipment on an icing research aircraft is described. It includes an icing rate indicator, which has operated perfectly on all icing flights performed to date (approx. 70 hours). Its three output signals, icing rate on sensor, sensor defrost frequency, and weight of ice accretion on sensor, were recorded during these flights. In some special flights, photographs were taken of ice accretion on a metal rod of the same diameter as the sensor of the icing rate indicator. Some of the conclusions reached were as follows: even at temperatures of approx. -4.5 C, only a proportion of the water in incoming supercooled cloud particles remained attached in the form of ice to the sensor rod. The sensitivity of the output signal ice accretion rate as an index for short term total water content, where short term means for approx. 2 seconds flight through cloud, decreased as cloud inhomogeneity increased. In strong inhomogeneous clouds, this output signal was not found to exhibit a clear dependency on total water content. ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N90-29693# Case Western Reserve Univ., Cleveland, OH. Center for Electrochemical Sciences.
ELECTROCHEMICAL CHARACTERISTICS OF ACID ELECTROLYTES FOR FUEL CELLS Annual Report, 1 Jan. - 31 Dec. 1989
R. Adzic, D. Gervasio, K. Kanamura, A. Razaq, M. Razaq, and Ernest B. Yeager 31 Jan. 1990 67 p
(Contract GRI-5084-260-1108)
(PB90-244385; GRI-90/0127) Avail: NTIS HC A04/MF A01 CSCL 10A

Five topics investigated by the Gas Research Institute (GRI) contractors at Case Western Reserve University (CWRU) during the past year included: (1) electrochemical evaluation of perfluorinated electrolyte, (2) the Nafion solid polymer electrolyte (SPE) fuel cell, (3) electrochemistry of single crystal Pt electrodes in acid solution, (4) catalytic effects of adatoms entrapped on electrode surfaces by bipolar or monopolar ion exchange membrane layers, (5) investigations of the Fleischmann-Pons phenomenon. The principal objective of the project is to evaluate new acid electrolytes. Electrochemical evaluation was made for two bisphosphonic acids as a replacement for phosphoric acid as a fuel cell electrolyte, and also a bis-sulfonyl carbon acid as an additive to concentrated phosphoric acid electrolyte for acid H2-O2 fuel cells. Electrochemical characteristics were found for these new perfluorinated acids. GRA

N90-29694# Naval Postgraduate School, Monterey, CA.
INVESTIGATION OF A HEAT DRIVEN THERMOACOUSTIC PRIME MOVER M.S. Thesis
Hsiao-Tseng Lin Dec. 1989 75 p
(AD-A223928) Avail: NTIS HC A04/MF A01 CSCL 10/2

The work output of a heat driven thermoacoustic prime mover was investigated. The experimental approach was to measure the frequency response of both a simple resonant tube and a prime mover for a variety of values of mean gas pressure and applied temperature difference across the prime mover stack. A least squares fit to the frequency response yields the quality factor which can be compared to predictions based on a short stack, boundary layer approximation theory. The results are reported of measurements made on the lowest three modes of the prime mover in helium for mean gas pressures between approximately 170 kPa and 500 kPa and the applied temperature differences between zero and onset. The signal waveforms of the sound generated by the prime mover above onset at a mean gas pressure of 308 kPa are also reported. Results for the resonant tube have at most 3 percent difference with theory. For the prime mover, the measurements generally agree with predictions for the fundamental mode except close to onset. This agreement between measured and predicted results worsens with decreasing mean gas pressure. Agreement is poor for the second and third modes for all pressures used. Finally, the sound generated by the prime mover above onset is highly distorted, and the distortion becomes more severe as the temperature difference increases. The peak positive pressure amplitude of this signal at temperature difference of 325, 368, and 453 C are 1.1, 4.4, and 7.9 percent. GRA

N90-29695# Air Force Office of Scientific Research, Bolling AFB, Washington, DC. Astronautics Lab.
PROCEEDINGS OF THE HIGH ENERGY DENSITY MATERIALS CONTRACTORS CONFERENCE
Larry P. Davis, ed. and Francis J. Wodarczyk, ed. May 1990 407 p Conference held in Long Beach, CA, 25-28 Feb. 1990
(AF Proj. 2303)
(AD-A223793; AFOSR-TR-90-0743) Avail: NTIS HC A18/MF A03 CSCL 20/5

This report includes these topics: Limitations on Stored Energy Densities in Systems of Separated Ionic Species, Matrix Isolation Spectroscopy of Metal Atoms Generated by Laser Ablation, Photogeneration and Storage of Atomic Radicals in van der Waals Solids, High Energy Density Systems in Cryogenic Media: The Production and Reaction of Atoms and Radicals, A Percolation Theory of Solid State Chain Reactions, Energy Storage and Conversion in Solid Hydrogen, and Metal-Doped H2. GRA

N90-29696# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
BASIC STUDIES OF 3-V HIGH EFFICIENCY CELL COMPONENTS Annual Report, 15 Aug. 1988 - 14 Aug. 1989
M. S. Lundstrom, M. R. Melloch, R. F. Pierret, M. S. Carpenter, H. L. Chuang, A. Keshavarzi, M. E. Klausmeier-Brown, G. B. Lush, J. M. Morgan, and T. B. Stellwag Jul. 1990 81 p Prepared in cooperation with Purdue Univ., Lafayette, IN

(Contract DE-AC02-83CH-10093)
(DE90-000360; SERI/TP-211-3904) Avail: NTIS HC A05/MF A01

This project's objective is to improve our fundamental understanding of the generation, recombination, and transport of carriers within III-V homo- and heterostructures. The research consists of fabricating and characterizing solar cell building blocks such as junctions and heterojunctions as well as basic measurements of material parameters. A significant effort is also being directed at characterizing loss mechanisms in high-quality, III-V solar cells fabricated in industrial research laboratories throughout the United States. The project's goal is to use our understanding of the device physics of high-efficiency cell components to maximize cell efficiency. A related goal is the demonstration of new cell structures fabricated by molecular beam epitaxy (MBE). The development of measurement techniques and characterization methodologies is also a project objective. We expect that the insight into III-V device physics occurring during the course of this work will help to identify paths toward higher efficiency III-V cells. This report describes our progress during the fourth year of the project. The past year's efforts centered on completing studies of heavy doping effects in p(sup +)-GaAs and assessing the importance of similar effects in n(sup +)-GaAs, and at continuing research on characterizing, controlling, and passivating perimeter recombination currents. We also initiated work to identify the dominant loss mechanism in Al(sub 0.2)Ga(sub 0.8) As solar cells and brought on-line a new MBE growth facility and demonstrated the high-quality of the films by fabricating, with assistance from Spire Corporation, 23.8 percent 1-sun solar cells. DOE

N90-29697# Midwest Research Inst., Golden, CO.
TWO TERMINAL CuInSe2 BASED CASCADE CELLS
B. N. Baron, R. W. Birkmire, B. E. McCandless, and J. E. Phillips Jul. 1990 24 p Prepared in cooperation with Delaware Univ., Newark, DE
(Contract DE-AC02-83CH-10093)
(DE90-000363; SERI/TP-211-3914) Avail: NTIS HC A03/MF A01

This report presents results and conclusions of a two-year research program on multijunction thin-film solar cells using a CuInSe2 heterojunction for the low-band-gap bottom cell and either an a-Si:H (E(sub g) = 1.8 eV) or a CdTe (E(sub g) = 1.5 eV) heterojunction for the high-band-gap top cell in a monolithic two-terminal cascade structure. Photochemical vapor deposition was used to deposit a-Si cells. The presence of a CuInSe2/(CdZn)S cell in the a-Si deposition reactor did not introduce contaminants or adversely affect the performance of conventional p-i-n cells. Procedures were developed for fabricating monolithic cascade devices with the configuration ITO/a-Si(n-i-p)/ZnO/(CdZn)-S/CuInSe2/Mo/glass. A prototype two-terminal a-Si/CuInSe2 cascade cell had an open-circuit voltage over IV and an efficiency of 5.8 percent. Physical vapor deposition with extrinsic doping was studied as a preparation technique for depositing low-resistivity p-type CdTe on transparent contact materials at low temperatures. DOE

N90-29698# Sandia National Labs., Albuquerque, NM.
ELECTRONIC AND PHOTONIC POWER APPLICATIONS
R. J. Walko, C. S. Ashley, C. J. Brinker, S. T. Reed, C. L. Renschler, T. J. Shepodd, R. E. Ellefson, J. T. Gill, and L. E. Leonard (Department of Energy, Germantown, MD.) 1990 15 p Presented at the Radioluminescent Technology Conference, Annapolis, MD, 25-26 Sep. 1990
(Contract DE-AC04-76DP-00789)
(DE90-015567; SAND-90-2130C; CONF-9009201-1) Avail: NTIS HC A03/MF A01

Efficient conversion of radioactive decay to electrical power has been the goal of a number of past research efforts. One of these was the Elgin-Kidde nuclear battery. In this concept promethium-147 was used as a beta source which was then mixed with a phosphor to produce a radioluminescent (RL) source of light. The light source was coupled to silicon photovoltaic converters to create electricity. This photoelectric approach is being revisited using tritium based solid state compounds and advanced gas concepts to produce RL light sources being disclosed at this conference. Efficient conversion of the RL light energy to electrical energy imposes certain requirements on the semiconductor converter. These requirements will be discussed. Projections of power source electrical and physical characteristics will be presented based on reasonable design parameter assumptions. The words Power Supply usually evoke a vision of a rotating machine or chemical battery. However, today's technology is making increasing use of photonics, where information and even power can be moved through optical fibers. Brighter volumetric RL light sources open a whole new range of photonics-based applications, while solid state tritiated compounds provide the foundation for improved mechanical adaptability and safety. DOE

N90-29699# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
ELECTROCHEMICAL EVALUATION OF NEW FLUOROSULFONIC AND FLUOROPHOSPHONIC ACIDS AS FUEL CELL ELECTROLYTES
M. H. Saffarian and P. N. Ross Dec. 1989 68 p Revised
(Contracts DE-AC03-76SF-00098; GRI-5086-260-1229)
(DE90-016626; LBL-27025-Rev; GRI-90/0120) Avail: NTIS HC A04/MF A01

The objective of this project was to evaluate a series of new fluorosulfonic and fluorophosphonic acids as alternative fuel cell electrolytes having superior performance than phosphoric acid. The procedure for the evaluation of new acids was a two stage process, the first stage being physicochemical property measurements (equivalent weight, state of hydration, conductivity of aqueous solutions) and preliminary electrochemical property measurement using cyclic voltammetry. If the results in the first stage appeared promising, further electrochemical evaluation was begun using either the purified acid by itself in pH = 1 solutions (if a sufficient quantity of acid were available) or the purified acid added to pre-purified 85 percent phosphoric acid, and measurement of oxygen reduction kinetics either in a rotating disk electrode (RDE) cell or in a small (1 ml) fuel cell. DOE

N90-29700# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany, F.R.). Fachgruppe Solare Energietechnik.
SOME STUDIES RELATED TO A NEW HEXAGONAL COMPOUND PARABOLIC CONCENTRATOR (HCPC) AS A SECONDARY IN TANDEM WITH A SOLAR TOWER
Deivarajan Suresh 1990 39 p
(DLR-FB-90-12; ISSN-0171-1342; ETN-90-97627) Avail: NTIS HC A03/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 16.50 Deutsche marks

Secondary concentrators operate in the focal plane of a point focusing system such as a paraboloidal dish or a tower and, when properly designed, are capable of enhancing the overall concentration ratio of the optical system at least by factor of two to five. The viability of using different shapes was demonstrated both analytically as well as experimentally in recent years, including Compound Parabolic Concentrators (CPCs) of circular cross section and 'trumpets' as secondaries. Current research effort is centered around a HCPC (Hexagonal CPC). Major areas addressed include an overview on the state of development of secondary concentrators, some background information related to the design of a HCPC, the results of an analytical study on the thermal behavior of this HCPC under concentrated flux conditions, and a computer modeling for assessing the possible thermal interactions between the secondary and a high temperature receiver. ESA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N90-29701# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
ATMOSPHERIC METHANE DATA FOR THE PERIOD 1983-1985 FROM THE NOAA/GMCC GLOBAL COOPERATIVE FLASK SAMPLING NETWORK
Patricia M. Lang, L. Paul Steele, Russell C. Martin, and Ken A. Masarie Mar. 1990 97 p Sponsored by NOAA, Boulder, CO (PB90-208588; NOAA-TM-ERL-CMDL-1) Avail: NTIS HC A05/MF A01 CSCL 13B

Details of relevant aspects of the NOAA Global Monitoring for Climate Change (GMCC) program to measure atmospheric methane concentrations through its global, cooperative, flask sampling network are discussed. These aspects include the history of the development of the program; details of the sampling network; the flasks and the flask sampling methods; the analytical instrumentation and methods; and the calibration gases and methods. The data from individual flask samples are tabulated, as are the monthly average methane concentrations. Through adequate documentation it is more likely that the full value of these methane measurements will be realized in long-term studies of the greenhouse effect and climate change. GRA

N90-29702 Ohio State Univ., Columbus.
SIMULATION AND MEASUREMENT OF THE HEAT EXCHANGE BETWEEN THE URBAN CANOPY AND BOUNDARY LAYERS Ph.D. Thesis
Gerald Michael Mills 1989 233 p
Avail: Univ. Microfilms Order No. DA9011223

The energy exchanges that occur within city street canyons and the interactions between canyon air and the overlying atmosphere are examined. The character of both the urban canopy and urban boundary layers is partly controlled by these interactions which occur across an interface at roof level. The method employed is one of numerical simulation and testing. The simulation is accomplished by considering an urban canyon which is uniform and infinite in the along-canyon direction. The processes responsible for heat exchange at canyon surfaces and into/out of the canyon air volume are simulated on a computer. Model results compare favorably to measurements of energy fluxes at a real canyon site by other researchers. A field experiment was established to validate the mechanisms on which the model is based and to evaluate its predictions. The results of the field measurements were unexpected in that they suggested that the canyon surfaces exchanged little sensible heat with their environment. This result contradicted the findings of others for wider canyons. Interaction between the urban canopy and boundary layers appears to be a function of the height to width ratio of the canyon. The measurements also failed to confirm the existence of the sensible heat exchange mechanism embodied in the model. In spite of this, the model simulated the invariant form of the measured sensible heat exchange at the canyon top and correctly concluded that the substrate heat exchange was the dominant component in the canyon energy balance. The magnitude and the form of the measured values of both net radiation at the canyon top and canyon surface temperatures were generally predicted well by the model. Dissert. Abstr.

N90-29703 California Univ., Irvine.
TREND ANALYSIS OF TOTAL OZONE DATA Ph.D. Thesis
Neil Richard Peter Harris 1989 357 p
Avail: Univ. Microfilms Order No. DA9014248

The total column ozone data for many Dobson stations are examined for the existence of long-term changes, principally in the period 1965 to 1986. Analysis of the measurements taken at Arosa, Switzerland from August 1931 to July 1988 reveals a statistically significant wintertime loss in recent years of about 6 percent compared to historic values. Examination of data from several other ground stations gave similar results, and in addition incongruous features were found in many of the published records. Bojkov (1987/8) produced a set of provisionally revised data by adjusting the data using information about the Dobson instrument calibrations made available by the individual stations. Similar wintertime losses are found in an analysis of this provisionally revised set of data as are found in the published data. Multiple regression analyses were performed using a model which seeks trends on a monthly basis after allowance for the effects of the solar cycle and the quasi-biennial oscillation. Sensitivity studies are presented which show the robustness of these results to such factors as the length of time considered, the solar cycle, the injection of nitrogen oxides by the nuclear bomb tests which were carried out in the atmosphere in the early 1960s, and the assumed nature of the loss. The seasonal and the latitudinal variations of these losses are qualitatively similar to the predictions of the current 2-D photochemical models of the atmosphere. However the observed losses are greater than the predicted losses by as much as a factor of four at 60 deg N in winter. Finally there is some evidence for longitudinal variations in both the observed trends and in the observed response of total ozone to the atmospheric bomb tests of the early 1960s. Dissert. Abstr.

N90-29704# Committee on Commerce, Science, and Transportation (U.S. Senate).
GLOBAL CLIMATE CHANGE: SEEKING A GLOBAL CONSENSUS
Washington GPO 1990 60 p Hearing before the Committee on Commerce, Science, and Transportation, 101st Congress, 2d Session, 14 Jun. 1990
(S-Hrg-101-842; GPO-33-588) Avail: Committee on Commerce, Science, and Transportation, Senate, Washington, DC 20510 HC free; also available SOD HC $2.00 as 552-070-08819-5

The science of global change was discussed in a hearing before the Senate Committee on Commerce, Science, and Transportation. Reports from three Working Groups of the Intergovernmental Panel on Climate Change (IPCC) were presented. IPCC was established to promote the cooperation of more than 50 countries in combatting global climate changes with policies and action. Working Group 1 tried to differentiate what was certain, from what could be calculated with confidence, from what was less certain. They concluded that predictive capabilities and models need to be improved, and that sources of six of the greenhouse gases need to be better understood. Working Group 2 tried to evaluate the potential implications of climate change - both the environmental implications and the social and economic implications. It was concluded that there could be an unwelcome cost to maintaining the current level of food production, a decrease in animal and plant species, problems with water resources, flooding, soil erosion, landslides, and major health problems. Working Group 2 indicated an inability to analyze the likely social-economic impacts of climate change because available information is too diverse and controversial. However, issues for further debate were identified. Working Group 3, chaired by the U.S., tried to identify and consider strategies; i.e., potential options for limiting or adapting to climate change if such action is deemed necessary in the light of scientific evidence. This group has four subgroups: (1) Energy and Industry; (2) Agriculture and Forestry; (3) Coastal Zone Management; and (4) Resource Use and Management. The first two subgroups considered ways to limit greenhouse gas emissions; the other two considered measures for adapting to the impacts of climate change, e.g., sea level rise. Working Group 3 indicated a need for immediate adoption of economically feasible and environmentally justified options, including improved energy efficiency, cleaner energy sources, changes in agricultural land use, and reforestation, as well as widespread information dissemination, tailored to the socially, economically, and culturally diverse nations in IPCC. Senator Albert Gore, Jr., who presided over the hearing, expressed his disappointment in the failure of Working Group 3 to list specific goals or actions that might solve the problems, but noted that the U.S. representatives had, no doubt, acted in accord with the Administration. J.P.S.

N90-29705# Council on Environmental Quality, Washington, DC.
ENVIRONMENTAL QUALITY, 1970 - 1990 Annual Report No. 20
1989 519 p
(PB90-214610) Avail: NTIS HC A22/MF A03 CSCL 13B

The annual report to the Congress is a retrospective evaluation of the distance traveled since 1970 in environmental issues. Because the events of 1970 emphasized environmental quality and pollution control, the 20-year retrospective necessarily emphasizes them as well. The lack of attention to natural resource issues is a function not of disregard, but of history. Chapters are devoted to: The National Environmental Policy Act; Environmental Data and Trends; Environmental Science and Technology; Environmental Enforcement; Pollution Prevention; International Issues; and The Great Lakes. Author

N90-29706# Environmental Protection Agency, Rockville, MD. Air and Energy Engineering Research Lab.
SUCCESS OF EPA'S STRATOSPHERIC OZONE ENGINEERING RESEARCH
William J. Rhodes and Paul S. Shapiro (Environmental Protection Agency, Washington, DC.) 1990 12 p Presented at the 83rd Annual Meeting of the Air and Waste Management Association, Pittsburgh, PA, 24-29 Jun. 1990
(PB90-246265; EPA/600/D-90/084) Avail: NTIS HC A03/MF A01 CSCL 13B

Recent successes and work in progress on EPA's stratospheric ozone engineering research are summarized. The Montreal Protocol and U.S. regulations implementing the Protocol necessitate that engineering solutions be found and implemented to avoid the use of certain chlorofluorocarbons (CFCs) and halons. CFCs and halons are used for solvents, refrigerants, aerosol propellants, foams, and fire protection. Nearly all EPA activities in this program involve pollution prevention as the first alternative. This includes alternative processes, alternative chemicals, alternative means of accomplishing the desired service, and recycling. Industry cooperation is needed in order to take advantage of industry's expertise, to get industry to buy into the solution, to conserve valuable time and resources, and to implement results rapidly. Since the problem will be solved only through international efforts, the U.S is also placing high priority on technical assistance to developing countries. GRA

N90-29707# Air Force Geophysics Lab., Hanscom AFB, MA. Ionospheric Physics Div.
EFFECTS OF THRUSTER FIRINGS ON THE SHUTTLE ENVIRONMENT 1: NEUTRAL GAS COMPOSITION Final Scientific Report
Donald E. Hunton 19 Jan. 1990 30 p
(AD-A224404; GL-TR-90-0056; GL-ERP-1057) Avail: NTIS HC A03/MF A01 CSCL 22/5

The changes in the neutral gas composition surrounding the Space Shuttle caused by the Shuttle's Vernier Reaction Control System (VRCS) and Orbital Maneuvering System (OMS) rocket engines were measured with a quadrupole mass spectrometer aboard STS-4. There are substantial differences between the measured composition changes in the payload bay and the calculated composition of the thruster exhaust plumes. These differences can be explained by kinematic effects that occur as the exhaust products collide with surfaces and other gas phase species in the Shuttle environment. Hydrogen, because of its light mass, is enriched in the return flux to the spacecraft, and tends to permeate the Shuttle environment during thruster firings more easily than heavier species. The effect of the thruster firings on the mass spectrometer also depended on the attitude of the instrument with respect to the velocity vector. When the mass spectrometer was pointed into the velocity vector, decreases in atomic oxygen concentration were detected during the engine firings. GRA

N90-29708# Lawrence Livermore National Lab., CA. Environmental Sciences Div.
EFFECTS OF INCREASED CO2 ON FOREST RESPONSE
Joseph H. Shinn May 1990 10 p Presented at the 83d Annual Meeting and Exhibition of the Air and Waste Management Association, Pittsburgh, PA, 24-29 Jun. 1990
(Contract W-7405-eng-48)
(DE90-015406; UCRL-JC-103410; CONF-900676-10) Avail: NTIS HC A02/MF A01

This document discusses our forests current response to the stress elevated CO2. The response to direct effects and to increased variability of precipitation and temperature may be more important than the response to change in average climate. We need to be prepared for the potential effects by formulating forest management plans and government policies based on enlightened risk assessments and adequate research. DOE

N90-29709# Lawrence Livermore National Lab., CA.
TROPOSPHERIC NITROGEN: THE INFLUENCE OF ANTHROPOGENIC SOURCES ON DISTRIBUTIONS AND DEPOSITION Final Report
J. E. Penner, C. S. Atherton, and J. J. Walton Apr. 1990 71 p
(Contracts W-7405-eng-48; EPA-DW-89932676-01-1)
(DE90-015408; UCRL-CR-104490) Avail: NTIS HC A04/MF A01

We present a three-dimensional modeling study of the global cycle of reactive nitrogen in the troposphere. We include all of the known major sources of NO(x): lightning, soil microbial activity, oxidation of N2O in the stratosphere and its transport to the troposphere, fossil-fuel combustion, and biomass burning. We present calculations for the gas-phase concentrations NO(x) and HNO3 throughout the troposphere, as well as for the deposition of nitrate in precipitation and by dry deposition. DOE

N90-29710# Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.
GRASSLAND/ATMOSPHERE RESPONSE TO CHANGING CLIMATE: COUPLING REGIONAL AND LOCAL SCALES
M. B. Coughenour, T. Kittel, W. Parton, and R. A. Pielke 28 Jul. 1990 29 p
(Contract DE-FG02-90ER-60932)
(DE90-015814; DOE/ER-60932/1) Avail: NTIS HC A03/MF A01

The ecological impacts of climate change and elevated CO2 projected to occur over the next 50 to 100 years due to globally increasing atmospheric levels of CO2 and other greenhouse gases are studied. The project study area is the North American Central Grasslands. The objectives are to develop multiscaled modeling systems linking extant state-of-the-art models from the ecological and atmospheric sciences with different spatial and temporal resolutions and to evaluate the response of grassland ecosystems to atmospheric change at regional and site scales. Responses are to be evaluated in terms of ecosystem function and potential biospheric impacts to climate. Fine scaled models were implemented of photosynthesis and decomposition, used regional and site level ecosystem models, in an unlinked mode, to simulate ecosystem response to climate and CO2 change, addressed scaling issues associated with linking models. DOE

N90-29711# Department of Energy, New York, NY. Environmental Measurements Lab.
THE SURFACE AIR SAMPLING PROGRAM Annual Report
R. J. Larsen and C. G. Sanderson Feb. 1990 120 p
(DE90-014873; EML-524) Avail: NTIS HC A06/MF A01

Tropospheric concentrations of radioactive debris from nuclear weapons tests are currently at or below the lower limits of detection of our analytical systems. Following the accident at the Chernobyl nuclear reactor in the USSR on April 26, 1986, fission products were detected at all sampling sites located in the Northern Hemisphere. Short-term variations in the concentrations of Be-7 and Pb-210 at sites in which weekly air filter samples are analyzed probably result from variations in meteorological factors. The data from quality assurance samples indicate that the reliability of the

air filter measurements are acceptable. The gross gamma-ray activity and the monthly mean surface air concentrations of Be-7, Zr-95, CS-137, Ce-144 and Pb-210 at sampling sites in the Surface Air Sampling Program during 1985 through 1988 are presented. The weekly mean surface air concentrations of Be-7, Cs-137, Ce-144 and Pb-210 are also presented for 11 sites. DOE

N90-29712# Oak Ridge National Lab., TN.
SAMTRACK: A SAMPLE TRACKING SYSTEM FOR ENVIRONMENTAL MONITORING
B. M. Horwedel 1990 9 p Presented at the Data Analysis and Interpretation for Environmental Surveillance Conference, Lexington, KY, 5-7 Feb. 1990
(Contract DE-AC05-84OR-21400)
(DE90-016026; CONF-9002111-2) Avail: NTIS HC A02/MF A01

The Environmental Monitoring and Compliance Section (EMC) is responsible for the development and implementation of an environmental program to ensure compliance with all Federal, state, and Department of Energy requirements for the prevention, control, and abatement of environmental pollution; monitor the adequacy of containment and effluent controls; and assess impacts of releases from ORNL facilities on the environment. Each month over 1000 samples of air, water, animals, and vegetation are collected and analyzed for contamination. A sample tracking system (SamTrack) was developed to automate the bookkeeping and report generation procedures required by EMC. SamTrack makes it possible for EMC to monitor individual samples from the time of submission to Analytical Chemistry Division (ACD) through the electronic transfer of analytical results. SamTrack dynamically maintains a sample status database. At anytime a variety of reports can be generated showing the status of samples being processed. Three basic reports reflect the status of the entire sample database: samples that have been submitted for analysis; samples that have completed analysis; and, samples with incomplete analysis. This paper presents the needs for a sample tracking system, how SamTrack addresses those needs, and future modifications that would improve the implementation of SamTrack. DOE

N90-29713 Royal Netherlands Meteorological Inst., De Bilt. Dynamical Meteorology Dept.
THE EFFECTS OF A DOUBLING OF ATMOSPHERIC CO2 ON THE STORMTRACKS IN THE CLIMATE OF A GENERAL CIRCULATION MODEL
P. C. Siegmund Jan. 1990 19 p Sponsored by Netherlands Organization for Scientific Research
(KNMI-WR-90-01; ISSN-0169-1651; ETN-90-97652) Copyright
Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

The effect of a doubling of the atmospheric CO2 content on the stormtracks in the climate of a general circulation model is determined. Stormtracks are defined as areas with pronounced geopotential height variability in the 2.25 to 6 day range. A band-pass filter is designed which filters these periods out of the spectrum. For the analysis the doubled CO2 experiment performed by Wilson and Mitchell (1987) is used. Significant decreases (at a 95 percent level of confidence) of the bandpass rms field of the transient part of the 500 hPa height occur over the eastern part of the Pacific stormtrack, over the Atlantic stormtrack off the west coast of North America and south east of Africa. Significant increases occur in very high latitudes of the Northern Hemisphere. ESA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N90-29714*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE WORLDWIDE IONOSPHERIC DATA BASE
Dieter Bilitza Apr. 1989 107 p
(NASA-TM-101823; NSSDC/WDC-A-R/S-89-03; NAS 1.15:101823) Avail: NTIS HC A06/MF A01 CSCL 04A

The worldwide ionospheric data base is scattered over the entire globe. Different data sets are held at different institutions in the U.S., U.S.S.R., Australia, Europe, and Asia. The World Data Centers on the different continents archive and distribute part of the huge data base; the scope and cross section of the individual data holdings depend on the regional and special interest of the center. An attempt is made to pull together all the strings that point toward different ionospheric data holdings. Requesters are provided with the information about what is available and where to get it. An attempt is also made to evaluate the reliability and compatibility of the different data sets based on the consensus in the ionospheric research community. The status and accuracy of the standard ionospheric models are also discussed because they may facilitate first order assessment of ionospheric effects. This is a first step toward an ionospheric data directory within the framework of NSSDC's master directory. E.R.

N90-29715 California Univ., Los Angeles.
AN OBSERVATIONAL STUDY OF THE CIRCULATION IN THE SOUTHERN HEMISPHERE STRATOSPHERE Ph.D. Thesis
John Damon Farrara 1989 196 p
Avail: Univ. Microfilms Order No. DA9014200

The dynamical processes that shape the three-dimensional evolution of the circulation in the Southern Hemisphere stratosphere during winter and spring are studied using observational data. Limited use is also made of a three-dimensional primitive-equation model of the circulation in the middle atmosphere. The warming during spring 1982 is analyzed in detail and other events from an eight-year set are briefly surveyed. The zonal mean westerly jet moves poleward and downward in spring as strong, planetary-scale disturbances develop which contribute to the weakening of the stratospheric westerly vortex. The processes governing this weakening are discussed by reference to isentropic maps of Ertel's potential vorticity. Repeating life cycles of growth, eastward-movement and decay of anticyclones in the stratosphere are described and related to the behavior of quasi-stationary wave 1 and eastward-traveling wave 2. Evidence that the orography exerts a strong influence on the evolution of the final warming is presented. During the winter, the stratospheric jet stream shifts downward in response to seasonal variations in thermal forcing. The poleward and downward shift of the jet axis in an individual year is usually abrupt and occurs in association with an enhancement of planetary wave activity. The wave driving of the mean flow in the stratosphere generally has a dipolar structure with easterly accelerations near 40 S and westerly accelerations in polar latitudes. In the three examples (1980, 1984, and 1985) of large early winter stratospheric disturbances with a predominately zonal wavenumber one pattern in the dataset, the high and low centers developed in the same geographical region. In all three cases, observations suggest, that the growth of the stratospheric disturbances is due to the amplification of the zonal wavenumber 1 component of the flow at 100 mb. Dissert. Abstr.

N90-29716 Wisconsin Univ., Madison.
AN ANALYSIS OF THE CHARACTERISTICS OF ATMOSPHERIC PROFILES OBTAINED WITH THE HIGH RESOLUTION INTERFEROMETER SOUNDER (HIS) Ph.D. Thesis
Allen Hung-Lung Huang 1989 165 p
Avail: Univ. Microfilms Order No. DA9006881

Infrared radiance spectra observed from and simulated for the

High resolution Interferometer Sounder (HIS) were used for the retrieval of atmospheric temperature and water vapor profiles. Results indicate that the high vertical resolution of the HIS yields a good profile accuracy of temperature and water vapor.
Dissert. Abstr.

N90-29717 Utah Univ., Salt Lake City.
MECHANISM OF HABIT CHANGE FOR ATMOSPHERIC ICE CRYSTAL GROWTH Ph.D. Thesis
Qiu-Jiang Lu 1989 153 p
Avail: Univ. Microfilms Order No. DA9015207

The basic mechanism that controls the shape change of ice crystal with temperature and supersaturation, or so-called ice crystal habit change, was investigated. From the preliminary analysis of experimental data, it was found that surface kinetic processes on the crystal are responsible in controlling the habit change. Therefore, relevant surface factors and processes were identified first. One of the most important factors was the line tension, or the surface free energy on the side of the two-dimensional embryo. Based on the physical meaning of the line tension and the surface tension, their fundamental difference was clarified under ideal conditions. A method to represent the hexagonal ice crystal lattice under random hydrogen arrangement was developed. Applying this last method, the surface factors such as the line tension and the surface tension for the ideal ice crystal were computed by using the intermolecular potential of the water molecule. Roles of liquid-like layer, transitional liquid layer and interface roughening in the habit change was clarified. The ordinary Brunaeur-Emmett-Teller (BET) adsorption equation was modified to describe the ice crystal growth problem. Through these analyses, the origin of the habit change was traced to the unique characteristic of the hydrogen bond that expands during freezing of water. The same characteristic led to a minimum in the free energy of two-dimensional embryo formation on the crystal plane through the line tension, which was shown to be a function of chemical potential difference. The operation of the two-dimensional nucleation mechanism for ice crystal growth was thus confirmed. Semiquantitative simulation of the habit change process for ice crystals growing both in air and in vapor alone after considering various surface factors was carried out, and the results showed a reasonable agreement with experimental data. Dissert. Abstr.

N90-29718 Ohio State Univ., Columbus.
ZONAL WINDS BETWEEN 25 AND 120 km RETRIEVED FROM SOLAR OCCULTATION SPECTRA Ph.D. Thesis
Garrett Warren vanCleef, II 1989 307 p
Avail: Univ. Microfilms Order No. DA9011284

Atmospheric winds at heights between 25 and 120 km were retrieved with precisions of 5 m/s from the Doppler shifts of atmospheric absorption lines measured from a satellite-borne instrument. Lines of the upsilon(sub 3) CO2 and upsilon(sub 2) H2O rotation-vibration bands caused by gases in the instrument allowed the instrumental frequency scale to be absolutely calibrated so that accurate relative speeds could be obtained. The wind speed profiles determined from four sunset occultations and one sunrise occultation show remarkable similarities in the magnitudes and directions of the zonal wind velocities as functions of height. These wind profiles appear to be manifestations of atmospheric tides. The periodic heating of the atmosphere primarily by ozone absorption and water insolation can force global circulation of the upper atmosphere. The diurnal and semidiurnal Fourier components of the heating rates were shown to be significant in driving the tidal circulation. The linear or classical theory (Lindzen, Chapman, 1970); however, predicts wind speeds which grow exponentially with height due to the exponential decrease in the hydrostatic background pressure. The growth was found to lead to wind speeds much larger in amplitude than revealed by the spectroscopic measurements. The classical theory must break down in a nonlinear way and the consequences of nonlinear and adiabatic instabilities present in such growth in amplitude are discussed.
Dissert. Abstr.

N90-29719 Texas A&M Univ., College Station.
BAROTROPIC MECHANISMS ASSOCIATED WITH TROPICAL PLUME FORMATION Ph.D. Thesis
Cecilia Ann Askue 1989 201 p
Avail: Univ. Microfilms Order No. DA9015450

The tropical plume is an upper level phenomenon with greatest frequency of occurrence over the northeast Pacific. Primarily wintertime events, plumes transport energy poleward and may be transient systems comprising a Hadley circulation. Previous studies of tropical plumes have focused on plume development and on describing plume structure and statistical properties. Possible mechanisms involved in plume initiation are investigated. From a case study, barotropic mechanisms are hypothesized to be important in initiating tropical plumes. These mechanisms are investigated by means of a one-layer, barotropic, gridpoint model using the shallow water equations on an equatorial beta-plane. Particular attention is given to wave-wave interaction occurring between equatorially trapped normal modes and between these modes and perturbations from higher latitudes. The numerical results indicate that interaction among equatorially trapped Rossby modes shows promise as being a key element in plume initiation. The effects are particularly apparent when the Rossby wave state is perturbed by a disturbance resembling an upper level cyclonic circulation, such as frequently occurs when a midlatitude trough intrudes into the tropics. The effects of a Kelvin-wave-like basic state are limited: active responses are observed only in the westerly regime of the Kelvin wave but do not interact strongly with the Kelvin wave itself.
Dissert. Abstr.

N90-29720 Stanford Univ., CA.
SPECTRAL STRUCTURE AND GENERATION MECHANISM OF DUCTED VLF WHISTLER MODE SIDEBAND WAVES Ph.D. Thesis
Luiz Augusto Discher deSa 1990 93 p
Avail: Univ. Microfilms Order No. DA9017920

An accurate determination is made of the sideband structure of ducted VLF whistler mode waves transmitted from Siple Station and observed at Lake Mistissini, Quebec. Single- and double-frequency transmissions are analyzed. Single-frequency sidebands are shown to be due to interactions between the input wave and harmonics of 60 Hz present within the duct. Sideband spectra are explained as due to wave-wave interactions occurring in the magnetosphere through electron cyclotron resonances, the line intensities required for such interactions being low. Resonances can be located outside or inside the wave potential wells. Application of the KAM theorem to the electron equations of motion shows the possible sideband radiation frequencies. Both external and trapped resonances generate the same radiation spectrum with frequencies given by a very simple formula. The carrier trapping frequencies do not affect the sideband wave frequencies, and do not impose sharp constraints on either the spectrum bandwidth, the sideband line separation, or the maximum interacting carrier frequency separation. It was found that the inhomogeneity of the magnetic field of the earth introduces phase shifts on the equilibrium positions of the resonances discussed. Those phase shifts, whether time dependent or not, will be translated at the receiving station as frequency shifts in the observed sidebands. A strong enough inhomogeneity will destroy a resonance completely. It was found that trapped resonances are much more resilient to the effects of the inhomogeneity than external resonances, this being the reason why extremely weak carriers can produce sizable and readily observable sidebands when they interact with stronger carriers.
Dissert. Abstr.

N90-29721 Washington State Univ., Pullman.
WIND TUNNEL, FIELD, AND NUMERICAL INVESTIGATIONS OF PLUME DOWNWASH AND DISPERSION AT AN ARCTIC INDUSTRIAL SITE Ph.D. Thesis
Alex Brian Guenther 1989 178 p
Avail: Univ. Microfilms Order No. DA9015994

The influence of the arctic atmospheric boundary layer and the complex flow pattern generated by building clusters is investigated on dispersion from a buoyant source. This was

accomplished by analyzing data from wind tunnel, field, and numerical dispersion experiments for flow around a specific Prudhoe Bay, Alaska oil-gathering center. The results were used to describe plume downwash and the arctic boundary layer and to evaluate current Gaussian plume downwash techniques. Field observations indicate that the winter-time tundra surface has a very small surface roughness. A persistent temperature inversion was observed near the cold tundra surface and was attributed to the limited solar insolation and a relatively warm maritime-influenced air mass. Observations of turbulence and surface layer structure at heights above 15 m are similar to measurements made at lower latitudes. Field tracer measurements indicate that plume downwash and dispersion dominates the distribution of ground-level concentrations near the buoyant, short stack sources typical of arctic industrial facilities. An order of magnitude increase in maximum concentration occurs as wind speed increases from 5 to 8 m/s and another order of magnitude increase occurs as wind speed increases to 16 m/s. A three-dimensional, two-equation (k-epsilon) turbulence closure numerical model was capable of simulating the mean streamline bending, turbulence enhancement, and velocity defects observed in the recirculation cavity and building wake downwind of buildings. This technique provides a potential alternative to the wind tunnel and field studies which are currently the only means of estimating accurately ground-level concentrations near arctic industrial facilities. Dissert. Abstr.

N90-29722# National Center for Earthquake Engineering Research, Buffalo, NY.
CATALOG OF STRONG MOTION STATIONS IN EASTERN NORTH AMERICA
R. W. Busby 3 Apr. 1990 76 p Prepared in cooperation with Lamont-Doherty Geological Inst., Palisades, NY
(Grant NSF ECE-86-07591)
(PB90-251984; NCEER-90-0004) Avail: NTIS HC A05/MF A01 CSCL 08K

The catalog contains information on all strong motion stations operating in Eastern North America known to the National Center for Earthquake Engineering Research (NCEER). The location, coordinates, installation dates, type of instrument, operator, structure type and size, and site geology are listed for each station. The format of the catalog is patterned after the United States Geological Survey (USGS) Open-File Report 81-664, 'Western Hemisphere Strong-Motion Accelerograph Station List-1980' but the entries have been updated as of January 1990. There are 237 stations listed in the catalog which include 414 recording instruments. One third of these stations are intended to record free-field ground motion while the rest are associated with large engineered structures. The relationship of station location to seismicity is shown in a series of figures and a method is described to predict peak acceleration levels from an earthquake where the magnitude and distance to station are known. GRA

N90-29723# Emmanuel Coll., Boston, MA.
IONOSPHERIC IRREGULARITIES: SOURCE, STRUCTURE, PLASMA PROCESSES AND EFFECTS ON SENSOR SYSTEMS Final Report, 2 Oct. 1986 - 1 Oct. 1989
Sunanda Basu, Cesar Valladares, Eileen MacKenzie, Clifford Bryant, and Patricia Doherty 31 Oct. 1989 230 p
(Contract F19628-86-K-0038; AF Proj. 4643; AF Proj. 2310)
(AD-A223908; GL-TR-89-0293) Avail: NTIS HC A11/MF A02 CSCL 04/1

A multi-technique approach was used at a number of geophysically interesting locations to determine various sources of high latitude irregularities, their occurrence characteristics and effects on sensor systems. Auroral scintillation morphology and irregularity anisotropy were determined using HiLat satellite data obtained at Tromso. Global scintillation characteristics were determined as a function of the sunspot cycle and a high latitude scintillation review was prepared reflecting the improved understanding of different sources of irregularity generation. A high latitude campaign mounted under the auspices of the Coupling, Energetics, and Dynamics of Atmospheric Regions (CEDAR) initiative provided multiple diagnostic studies of the polar cusp, polar cap patches and sun-aligned arcs. Multiple sensor data on the DE-2 satellite were utilized to isolate two different classes of plasma instabilities responsible for structuring plasma at high latitudes. Finally, an active experiment was performed with the high power HF heater at Tromso, Norway to study the characteristics of the artificially generated irregularities in the daytime sub-auroral ionosphere. GRA

N90-29724# SRI International Corp., Menlo Park, CA.
SATELLITE MEASUREMENTS OF MAGNETOSPHERIC POYNTING FLUX Final Report, Aug. 1968 - Mar. 1990
J. F. Vickrey, M. C. Kelley, and D. J. Knudsen 9 Mar. 1990 35 p
(Contract F19628-86-K-0044)
(AD-A224391; GL-TR-90-0060) Avail: NTIS HC A03/MF A01 CSCL 04/1

The first satellite observations of the Magnetospheric Poynting flux are presented for two presented for two passes of the HILAT satellite over the northern polar regions. The simultaneously measured energy input due to precipitating particles is also presented. The Poynting flux is in general agreement with an independent estimate of the Joule dissipation in the upper atmosphere. However, there are localized regions in both orbits of net upward Poynting flux, suggesting a neutral wind dynamo. Evidence for the existence of propagating Alfven waves as well as steady state current systems closed in the ionosphere are also presented. GRA

N90-29725# Northwest Research Associates, Inc., Bellevue, WA.
AN ASSESSMENT OF THE APPLICATION OF IN SITU ION-DENSITY DATA FROM DMSP TC MODELING OF TRANSIONOSPHERIC SCINTILLATION Final Report, 15 Sep. 1989 - 14 Mar. 1990
James A. Secan, Lee A. Reinleitner, and Robert M. Bussey 15 Mar. 1990 33 p
(Contract F19628-86-C-0195)
(AD-A224392; NWRA-CR-90-R060; GL-TR-90-0093) Avail: NTIS HC A03/MF A01 CSCL 04/1

Modern military communication, navigation, and surveillance systems depend on reliable, noise-free transionospheric radio frequency channels. They can be severely impacted by small scale electron-density irregularities in the ionosphere, which cause both phase and amplitude scintillation. Basic tools used in planning and mitigation schemes are climatological in nature and thus may greatly over- and under-estimate the effects of scintillation in a given scenario. The results are summarized of a 3 year investigation into the feasibility of using in-situ observations of the ionosphere from the USAF DMSP satellite to calculate estimates of irregularity parameters that could be used to update scintillation models in near real time. Estimates for the level of intensity and phase scintillation on a transionospheric UHF radio link in the early evening auroral zone were calculated from DMSP Scintillation Meter (SM) data and compared to the levels actually observed. The intensity scintillation levels predicted and observed compared quite well, but the comparison with the phase scintillation data was complicated by low-frequency phase noise on the UHF radio link. Results are presented from analysis of DMSP SSIES data collected near Kwajalein Island in conjunction with a propagation-effects experiment. Preliminary conclusions to the assessment study are: (1) the DMSP SM data can be used to make quantitative estimates of the level of scintillation at auroral latitudes, and (2) it may be possible to use the data as a qualitative indicator of scintillation activity levels at equatorial latitudes. GRA

N90-29726# Regis Coll., Weston, MA.
EFFECTS OF ENERGY, MOMENTUM AND PARTICLE TRANSPORT IN THE NEAR-EARTH SOLAR TERRESTRIAL SYSTEM Final Report, 2 Dec. 1986 - 1 May 1990
P. B. Anderson, E. M. Basinska-Lewin, M. E. Greenspan, J. H. James, and D. R. Weimer 1 Jun. 1990 83 p
(Contract F19628-86-K-0045)

(AD-A224393; GL-TR-90-0084) Avail: NTIS HC A05/MF A01 CSCL 04/1

This work has included the scientific studies of high-latitude plasma irregularities and the physics of the aurora, engineering of space environmental sensors, and data processing services. Scientific studies were conducted in the areas of energy dissipation, magnetosphere-ionosphere interactions and ionospheric plasma. Design work has been done on a series of plasma instruments for the Defense Meteorological Satellite Program (DMSP), the Combined Release and Radiation Effects Studies (CRRES), the Photovoltaic Array Space Power (PASP), the Interactions Measurements Payload for Shuttle (IMPS) and the NASA POLAR satellite program. Computer programs have been written to process RPA and Drift Meter data from the F8 and F9 DMSP satellites. GRA

N90-29727# Lowell Univ., MA. Center for Atmospheric Research.

INVESTIGATION OF STRUCTURE AND TRANSPORT PROCESSES IN THE HIGH LATITUDE IONOSPHERIC PLASMA USING GROUND BASED AND AIRBORNE DIGISONDES Final Report, 8 Aug. 1986 - 7 Dec. 1989

Bodo W. Reinisch, Klaus Bibl, Terence W. Bullett, Paul S. Cannon, and Geoffrey Crowley Jan. 1990 173 p

(Contract F19628-86-K-0036)

(AD-A224397; ULRF-455/CAR; GL-TR-90-0005) Avail: NTIS HC A08/MF A01 CSCL 04/1

The Digisonde 256, an advanced ionospheric sounder, is a new and exciting tool for obtaining important ionospheric information. Like a conventional ionosonde, the Digisonde yields vertical electron density profiles. However, the antenna arrangement and sophisticated data handling system also permits plasma drift velocities to be derived from the ionospheric reflections. The F-region plasma drifts perpendicular to the magnetic field at the E x B velocity, and electric fields can therefore be deduced from the Digisonde drift measurements. This final report describes the development of the drift analysis techniques and highlights some of the exciting scientific results obtained by the Air Force Digisonde network, including the Airborne Ionospheric Observatory (AIO) of the Geophysics Laboratory. Digisonde data have been applied to the study of large scale ionospheric features such as high latitude convection, polar cap patches, sun aligned arcs, and the midlatitude trough. GRA

N90-29728# Denver Univ., CO. Dept. of Physics.

MEASUREMENTS OF THE HIGH ALTITUDE INFRARED CHARACTERISTICS OF THE ATMOSPHERE Final Report, 6 Jun. 1986 - 30 Sep. 1989

F. H. Murcray, F. J. Murcray, D. G. Murcray, A. Goldman, and R. D. Blatherwick Oct. 1989 60 p

(Contract F19628-86-K-0029)

(AD-A224401; GL-TR-89-0326) Avail: NTIS HC A04/MF A01 CSCL 04/1

Several aspects of radiative transfer studies in the stratosphere are discussed. These include modifications to the Stratospheric Cryogenic Interferometer Balloon Experiment (SCRIB) instrument to enhance the 1250 cm response and to improve its reliability. The results of a highly successful balloon flight on May 23, 1989 are discussed and a short interval in one of the spectra obtained is presented. The analysis of data from the SCRIBE flight of July 5, 1984 as well as the data from two very high resolution solar interferometer flights are discussed. The analysis of the SCRIBE flight resulted in a daytime measurement of N2O5 variation. The high resolution data yielded information on O3 isotopic abundances in the stratosphere and also on improved line parameters for the O3 bands in the 10 m region. GRA

N90-29729# Lowell Univ., MA. Center for Atmospheric Research.

HIGH POWER OBLIQUE INCIDENCE HF IONOSPHERIC MODIFICATION Scientific Report No. 1, 25 Feb. 1987 - 25 Feb. 1988

Gary S. Sales and Ian G. Platt Apr. 1990 48 p

(Contract F19628-87-K-0012)

(AD-A224402; ULRF-456/CAR; GL-TR-90-0078; SR-1) Avail: NTIS HC A03/MF A01 CSCL 04/1

To successfully perform the proposed ionospheric modification experiment (IONMOD) it is necessary to establish the range of the expected changes in the ionosphere, the parameters that offer the greatest likelihood of detection of these changes and the systems that can best carry out the appropriate measurements to detect them. The distributed region of the ionosphere is modeled as a spherical depletion region of varying depth and size. Three dimensional numerical ray tracing is then used to determine the expected magnitude and location of the amplitude and arrival angle deviations. These calculations indicate rather small changes, of the order of 3 dB in amplitude and about 0.5 deg in the elevation angle, with even smaller changes in the azimuth arrival angle. This leads to strong requirements for the measuring system in terms of antenna design and the signal to noise that must be achieved. Consider the basic concept of a probe system to make the required amplitude and arrival angle measurements. Such a system will be based upon the real time calculation of the Doppler spectrum of the signal on each antenna of the system and use the measured phase difference on each line in the spectrum, as an interferometer, to determine the arrival angle and amplitude. The requirements are determined for the signal to noise ratio that will permit the measurements with sufficient accuracy. The results indicate that sufficient measurement sensitivity of the probe system can be achieved with a transmitter power of 100 W continuous and an antenna preamplifier properly designed to be atmospherically noise limited. GRA

N90-29730# Northwest Research Associates, Inc., Bellevue, WA.

AN ASSESSMENT OF THE APPLICATION OF IN SITU ION-DENSITY DATA FROM DMSP TO MODELING OF TRANSIONOSPHERIC SCINTILLATION Technical Report No. 3, 15 Sep. 1988 - 14 Sep. 1989

James A. Secan and Lee A. Reinleitner 15 Sep. 1989 113 p

(Contract F19628-86-C-0195; AF Proj. 4643)

(AD-A222695; NWRA-CR-89-R0147; GL-TR-89-0264) Avail: NTIS HC A06/MF A01 CSCL 20/14

Modern military communication, navigation, and surveillance systems depend on reliable, noise-free transionospheric radio-frequency channels. They can be severely impacted by small-scale electron-density irregularities in the ionosphere, which cause both phase and amplitude scintillation. Basic tools used in planning and mitigation schemes are climatological in nature and thus may greatly over- and under-estimate the effects of scintillation in a given scenario. This report describes the second year of an investigation into the feasibility of using in-situ observations of the ionosphere from the USAF DMSP satellite to calculate estimates of irregularity parameters that could be used to update scintillation models in near real-time. Estimates for the level of intensity and phase scintillation on a transionospheric UHF radio link are calculated from DMSP Scintillation Meter (SM) data and compared to the levels actually observed. The intensity scintillation levels predicted and observed compare quite well, but the comparison with the phase scintillation data was complicated by low-frequency phase noise on the UHF radio link. Results are presented from analysis of DMSP SSIES data collected near Kwajalein Island in conjunction with a propagation-effects experiment. GRA

N90-29731# Australian National Univ., Canberra. Research School of Earth Sciences.

REGIONAL PHASE PROPAGATION IN THREE DIMENSIONALLY HETEROGENEOUS MEDIA Report, 1 Apr. 1989 - 31 Mar. 1990

Brian L. Kennett 11 Apr. 1990 104 p

(Grant AF-AFOSR-0330-89; ARPA Order 5299; AF Proj. 9A10)

(AD-A223279; GL-TR-90-0104; SR-1) Avail: NTIS HC A06/MF A01 CSCL 08/11

The interaction of regional seismic phases with complex structure can lead to a significant modification of the seismic wavefield with the result of masking the characteristics of the

source. A combination of theoretical, computational and observational studies were directed to elucidating the effect of heterogeneity on regional phases. A new method was developed for calculating the propagation of guided waves through a medium described by stochastic heterogeneity. This approach allows the estimation of the scattering contribution to the attenuation of Lg and Sn phases which can approach 30 percent for realistic heterogeneity structures. A ray based treatment was devised to describe the way in which the Lg phase is affected by changes in the shape of the crustal waveguide due to topography at the surface and the Mohorovicic discontinuity. GRA

N90-29732# National Center for Atmospheric Research, Boulder, CO.
GEOPHYSICAL TURBULENCE RESEARCH AT NCAR Final Report, 22 May 1987 - 31 Dec. 1989
Robert M. Kerr 2 May 1990 8 p
(Contract MIPR-ARO-103-89)
(AD-A223361; ARO-24407.5-GS) Avail: NTIS HC A02/MF A01 CSCL 20/4

Development of the community turbulence model at NCAR and its use for studying fundamental turbulence, convection, and stratified shear flow is discussed. GRA

N90-29733# Texas Univ. at Dallas, Richardson. Center for Space Sciences.
STUDIES OF IONOSPHERIC DYNAMICS UTILIZING DATA FROM DMSP Final Report, 1 Jan. 1987 - 31 Dec. 1989
R. A. Heelis and M. R. Hairston 22 Feb. 1990 44 p
(Contract F19628-87-K-0014)
(AD-A223370; GL-TR-90-0047(1)) Avail: NTIS HC A03/MF A01 CSCL 04/1

This report covers efforts primarily devoted to the reduction of ion drift meter data from the Defense Meteorological Satellite Program (DMSP) satellite. This work has required the development of sophisticated algorithms to generate in-situ ion drift velocity data with respect to the spacecraft and the derivation of an electrostatic potential distribution along the spacecraft track. This initial effort has been directed toward satisfying the needs of mathematical models of the high-latitude convection pattern, with some effort devoted to the improvement of the formulations currently in use. This report discusses the rationale for the preparation of data bases of the ion drift velocity and derived parameters from the DMSP data. The function of this computer code is described in detail to allow other users to make use of its capabilities. GRA

N90-29734# University Coll., London (England). Dept. of Physics and Astronomy.
ATMOSPHERIC STRUCTURE AND VARIABILITY Final Report, 1 Dec. 1988 - 30 Nov. 1989
David Rees and Timothy J. Fuller-Rowell Mar. 1990 9 p
(Contract F49620-87-C-0096)
(AD-A223439; AFOSR-90-07TR) Avail: NTIS HC A02/MF A01 CSCL 04/1

The contract has supported an extensive program of atmospheric and ionospheric modeling, aimed at examining atmospheric structure and variability, using the CRAY XMP-48 and the CRAY 2S machines. A technique of forcing tidal and other natural atmospheric fluctuations at the lower boundary of the present version of the 3-dimensional, time-dependent global thermosphere-ionosphere model was developed. Also, a series of numerical studies were performed in the modeled response of the thermosphere during a series of geomagnetic storms in 1981 and 1982, observed by the Dynamics Explorer-2 spacecraft. Further studies have concentrated on using these models for studies of thermosphere-ionosphere coupling, atmospheric density, lower atmospheric tides, participation in the analysis and interpretation of empirical data obtained during the Lower Thermosphere Coupling Study, the mid- and low-latitude ionospheric effects of geomagnetic storms, and for studies of the solar activity and geomagnetic activity causes of variations of lower thermospheric atomic oxygen and nitric oxide densities. GRA

N90-29735# Air Force Geophysics Lab., Hanscom AFB, MA. Earth Sciences Lab.
PROCEEDINGS OF THE 17TH ANNUAL GRAVITY GRADIOMETER CONFERENCE Environmental Research Papers
Christopher Jekeli, ed. and Gerald L. Shaw, ed. 28 Mar. 1990 313 p Conference held in Hanscom AFB, MA, 12-13 Oct. 1989
(AF Proj. 7600)
(AD-A223568; GL-TR-90-0067; GL-ERP-1059) Avail: NTIS HC A14/MF A02 CSCL 08/5

Fourteen papers were presented at this conference, reviewing the status of terrestrial gravity gradiometers, applications of gravity gradiometry and cryogenic gradiometer technology. The status of the Gravity Gradiometer Survey System (GGSS) was reviewed and the future of gradiometry was projected in terms of instrumentation and applications. The technical papers covered test program results, applications to gravity field mapping, gravity signal processing, geophysical interpretation, space applications, inertial navigation aiding, new instrumentation and application to strategic arms reduction treaty verification. This report consists of viewgraphs of the presentations. GRA

N90-29736# Pennsylvania State Univ., University Park.
A STUDY OF WATER VAPOR, ELECTRICAL PARAMETERS, AND RADIO PROPAGATION Final Technical Report, 1 Jul. 1979 - 30 Sep. 1987
John J. Olivero 10 Apr. 1990 12 p
(Contract N00014-79-C-0610)
(AD-A223582; PSU-CSSL-FR-90/1) Avail: NTIS HC A03/MF A01 CSCL 04/1

This has been an extended study of water vapor distributions in the middle atmosphere and their interaction with the D-region ionosphere. Water vapor measurements have been conducted using ground-based microwave radiometry-spectroscopy, both in the solar absorption and thermal emission modes. Radio-wave absorption observations were used to characterize the lower ionosphere. We were unable to establish a clear role for water vapor and large (H2O) cluster ions in D-region chemistry. The water vapor measurements are a unique data set and have been used to examine the vertical and seasonal structure of mesospheric H2O, ozone chemistry, noctilucent clouds, and atmospheric circulation issues. GRA

N90-29737# RADEX, Inc., Bedford, MA.
NASA RADIATION BELT MODELS AP-8 AND AE-8 Scientific Report No. 1, Jun. - Sep. 1989
Carolyn E. Jordan 30 Sep. 1989 26 p
(Contract F19628-89-C-0068; AF Proj. 7659)
(AD-A223660; GL-TR-89-0267; SR-1) Avail: NTIS HC A03/MF A01 CSCL 04/1

Empirical models AP-8 and AE-8 for the trapped protons and electrons in the Earth's radiation belts are currently available from NSSDC. These are the culmination of a series of models developed by J. I. Vette and colleagues. The initial models were begun in the mid-sixties with the most recent model, AE-8, being released in 1980. These models are based on data ranging from 1958 to 1970. They have been well documented by TREND, a group working under a contract with ESA, contains some information on this model. The only models which are still available from NSSDC are the most recent proton and electron models AP-8 and AE-8. A brief summary is presented of the modeling efforts to date based on information from Lemaire, Spjeldvik, and Rothwell. Results from AE8MAX, results from the models previously used at GL (AE6MAX + AEI7HI), and results from code provided by NSSDC are compared. GRA

N90-29738# IWG Corp., San Diego, CA.
A FEASIBILITY STUDY FOR D-REGION EQUATORIAL IONOSPHERE RESEARCH USING VLF RADIOWAVES Technical Report, 1 May 1989 - 15 Jan. 1990
V. E. Hildebrand 15 Jan. 1990 82 p
(Contract N00014-89-C-0134)
(AD-A223685) Avail: NTIS HC A05/MF A01 CSCL 04/1

Experiment feasibility is established and a plan is presented to explore dynamic properties of the equatorial D-region ionosphere. The objective is to derive geophysical information on the lower ionosphere at nighttime in near equatorial regions through the use of a new VLF radiowave measurement method which uses ionosphere mode conversion. The measurement technique uses VLF signals, that when propagating at a range of azimuthal angles (typically 190 to 360 deg) through the equatorial region (about + or - 20 magnetic latitude), undergo marked mode conversion. The mode conversion, as predicted by theory and shown by measurement, is so strong that many modes become near equal in amplitude, even modes that when entering the equatorial zone are more than 30 dB below the dominant mode. Signals are strongly mode 1 on entering the mode conversion zone, thus converted modal components provide information on ionosphere parameters causing the mode conversion process. This process is shown to be highly sensitive to ionosphere parameters. Spaced receivers located just within the mode conversion zone will provide data from a small reflection region, even though the transmitter is far away. Theoretical models of VLF propagation, used in an iterative inversion process, infer the parameters of the ionosphere. GRA

N90-29739# Scripps Institution of Oceanography, San Diego, CA. Marine Physical Lab.
PROCEEDINGS OF A WORKSHOP ON THE GEOELECTRIC AND GEOMAGNETIC ENVIRONMENT OF CONTINENTAL MARGINS
A. D. Chave, J. R. Booker, C. S. Cox, P. L. Gruber, L. W. Hart, H. F. Morrison, J. G. Heacock, and D. Johnson (Office of Naval Research, Arlington, VA.) Apr. 1990 47 p Workshop held in Arlington, VA, Nov. 1989
(Contract N00014-89-J-3064)
(AD-A223743; MPL-U-24/90; SIO-REF-90-20) Avail: NTIS HC A03/MF A01 CSCL 08/4

This report discusses basic research needs in electromagnetic (EM) geophysics relevant to one endeavor identified as important science issue and having a significant impact on Navy nonacoustic ASW surveillance programs. A major ASW emphasis was placed on long range, deep ocean surveillance using passive acoustics and the subsequent tactical localization of submerged targets using passive and active acoustics or airborne magnetic anomaly detection (MAD). Because of recent and dramatic improvements in the acoustic quieting of foreign submarines, traditional forms of surveillance have lost some effectiveness. As a result, there is an increasing focus on long range, low frequency active acoustics in the deep ocean as a supplement to passive techniques, as well as more emphasis on acoustic barrier techniques. Reduced acoustic surveillance efficiency has also led to renewed interest in nonacoustic ASW methods, including those based on measurement of electric and magnetic fields. While EM field detection has potential uses in both the deep ocean and shallow water, this report emphasizes the latter. There are both immediate operational needs and important geophysical issues that dictate this emphasis. GRA

N90-29740*# Fermi National Accelerator Lab., Batavia, IL.
RELIC GRAVITATIONAL WAVES AND EXTENDED INFLATION
Michael S. Turner and Frank Wilczek (Princeton Univ., NJ.) Aug. 1990 11 p
(Grant NAGw-1340)
(NASA-CR-186469; NAS 1.26:186469; FERMILAB-Pub-90/178-A) Avail: NTIS HC A03/MF A01 CSCL 08G

In extended inflation, a new version of inflation where the transition from the false-vacuum phase to a radiation-dominated Universe is accomplished by bubble nucleation and percolation, bubble collisions supply a potent-and potentially detectable-source of gravitational waves. The present energy density in relic gravity waves from bubble collisions is expected to be about 10(exp -5) of closure density-many orders of magnitude greater than that of the gravity waves produced by quantum fluctuations. Their characteristic wavelength depends upon the reheating temperature T(sub RH): lambda is approximately 10(exp 4) cm (10(exp 14) GeV/T(sub RH)). If large numbers of black holes are produced, a not implausible outcome, they will evaporate producing comparable amounts of shorter wavelength waves, lambda is approximately 10(exp -6) cm (T(sub RH)/10(exp 14) GeV). Author

N90-29741# Alaska Univ., Fairbanks. Geophysical Inst.
A STUDY OF MAGNETIC FIELD RECONNECTION AND PLASMA PROCESSES IN THE MAGNETOSPHERE
L. C. Lee and S. I. Akasofu Jul. 1990 10 p
(Contract DE-FG06-86ER-13530)
(DE90-016117; DOE/ER-13530/T1; GI88-496) Avail: NTIS HC A02/MF A01

The basic plasma processes associated with magnetic reconnection in the earth's magnetosphere are studied in our proposed project. In the past year, several problems associated with the 2-D and 3-D nonlinear reconnection processes were investigated. The theoretical and simulation results from present magnetosphere study are also applicable to plasma research in the other fields such as thermonuclear fusion, solar physics, and astrophysics. In the past year, we have made important progresses on several research areas. A brief description of our research progresses is presented and a list of our publications published in the year of 1989 to 1990 is also included. DOE

N90-29742 Politecnico di Milano (Italy). Dipartimento di Elettronica.
ELASTIC INTERFACES [INTERFACCIA ELASTICA]
Giuseppe Drufuca 1990 45 p In ITALIAN; ENGLISH summary
(Rept-90-003; ETN-90-97364) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The response of a flat elastic interface to a plane unlimited monochromatic wave system is studied. The description of the wave propagation and scatter matrices works for any incident plane wave, including evanescent waves. The analysis of the calculations show some anomalies. It is concluded that it is better to describe the waves in terms of horizontal slowness than in terms of incidence angles to avoid the complications introduced by the double root of the slowness. ESA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N90-29743 Nottingham Univ. (England).
NUMERICAL SIMULATION OF THE LIGHTNING RETURN STROKE Ph.D. Thesis
Marcos Andre DaFrotaMattos 1988 231 p
Avail: Univ. Microfilms Order No. BRD-88188

Several lightning return stroke models were developed in this work. Initially very simple models were developed, and subsequently many of the main features of the channel were added. The corona effect, the geometrical parameters, non-linear losses, and the cloud losses are these features. To solve the RLC network model of the channel the numerical technique known as a transmission line model (TLM) was used. A numerical sensitivity study was made to analyze the influence of the filtering and the Gibbs effects on the results. A sensitivity study of the channel's parameters was also made. For the first time three of the main measured lightning channel quantities were calculated showing good agreement with observations. These quantities are the electromagnetic field, current waveshape at ground and the velocity of propagation. The surge impedance and the current rise-time were also calculated at all heights. Dissert. Abstr.

N90-29744 Rice Univ., Houston, TX.
A GLOBAL MODEL OF THUNDERSTORM ELECTRICITY AND THE PREDICTION OF WHISTLER DUCT FORMATION Ph.D. Thesis
Eileen K. Stansbery 1989 172 p
Avail: Univ. Microfilms Order No. DA9012871

A two-dimensional numerical model is created to calculate the electric field and current that flow from a thunderstorm source

into the global electrical circuit. The model includes a hemisphere in which the thunderstorm is located, an equalization layer, and a passive magnetic conjugate hemisphere. To maintain the fair weather electric field, the output current from the thunderstorm is allowed to spread out in the ionosphere or flow along the magnetic field lines into the conjugate hemisphere. The vertical current is constant up to approximately 65 km, decays and is redirected horizontally in the ionosphere. Approximately half of the current that reaches the ionosphere flows along magnetic field lines into the conjugate hemisphere while the rest is spread out in the ionosphere and redirected to the fair weather portion of the storm hemisphere. Our results show that it is important to include a realistic model of the equalization layer to evaluate the role of thunderstorm charging of the global circuit. The mapping of thunderstorm electric fields at middle and subauroral latitudes into the magnetic equatorial plane is studied. The geomagnetic field lines are assumed to be dipolar above approximately 150 km. The horizontal electric field computed in the ionosphere by our model is of sufficient size and shape for the formation of electron density irregularities in the magnetosphere. The mechanism involves a localized convection of ionization tubes by ExB drift. It is shown that the horizontal range of the electric field disturbance in the ionosphere must be within approximately 160 km to produce density irregularities necessary for the formation of whistler ducts, well within the predicted size of thunderstorm produced electric fields. Although the electric field strength at ionospheric heights depends sensitively on the conductivity profile, the results presented show that whistler duct formation is possible by thunderstorm generated electric fields. Dissert. Abstr.

N90-29745 Rice Univ., Houston, TX.
WINDSHEAR ESTIMATION ALONG THE TRAJECTORY OF AN AIRCRAFT Ph.D. Thesis
Ching-Yaw Tzeng 1989 105 p
Avail: Univ. Microfilms Order No. DA9012879

The application of the sequential gradient restoration algorithm (SGRA) to the estimation of the windshear along the trajectory of an aircraft is studied. Based on the measured trajectory data obtained from the digital flight data recorder (DFDR) of Flight Delta 191 (August 2, 1985, Dallas-Fort Worth International Airport), a nonlinear least-square problem is formulated. The performance index being minimized measures the deviation of the experimental trajectory (the altitude, the relative velocity, and the pitch attitude angle) from the computed trajectory, obtained by integrating the equations of motion of an aircraft in a vertical plane. Since the thrust and the aerodynamic forces enter directly in this dynamic formulation, a clear picture of the forces acting on the aircraft can be seen. The angle of attack is treated as a control, and the power setting is regarded as a known input. By assuming that the manufacturer-supplied aerodynamic and thrust data are dependable, the dynamically estimated vertical wind shows reasonable agreement with that obtained with the kinematic approach. However, the results obtained for the horizontal wind are less satisfactory. Upon modifying the manufacturer-supplied thrust and aerodynamic data with unknown multiplicative factors, a better agreement between the measured and computed trajectory can be achieved. Upon employing different combinations of the measured trajectory data, the relative importance of each data can be established. The horizontal distance data and the relative velocity data are found to have minor effect on the estimation results. The altitude data affect mostly the vertical wind, and the pitch attitude angle data are crucial to the estimation of both the horizontal and vertical winds. Dissert. Abstr.

N90-29746 Texas A&M Univ., College Station.
THREE-DIMENSIONAL NUMERICAL STUDY OF THUNDERSTORM DOWNDRAFTS AND ASSOCIATED OUTFLOW BOUNDARIES Ph.D. Thesis
Danny Raymond Pophin 1989 172 p
Avail: Univ. Microfilms Order No. DA9015566

Thunderstorm downdrafts and their associated outflow boundaries are numerically simulated using a high-resolution, time-dependent, three-dimensional model. The initial downdraft is initiated by specifying a distribution of precipitation at the top of the domain which initially has no vertical motion. Two initial thermodynamic profiles are used to represent the pre-environmental conditions for a Mesoscale Convective Complex (MCC). Several different initial and ambient conditions are used to simulate the effects of vertical shear, the type of precipitation falling through the storm and the radius of the precipitation core. The simulations indicate that the outflows and downdrafts are sensitive to the vertical profile of temperature and humidity, vertical wind shear, low-level inflow speeds, the type of precipitation and the radius of the precipitation shaft. One interesting result of the study relates to the formation and life cycle of the ring vortex associated with the downdraft. When a low-level shear is imposed against the forward outflow boundary the vortex in this region dissipates while the vortex on the rear flank of the storm is enhanced. As the shear in the lower levels is increased, the ring vortex on the front flank of the storm is slower in its downward propagation to the surface from its initiation point. The ring vortex in these simulations always formed in the region where the temperature profile first becomes adiabatic. In the simulations where the radius of the precipitation core is varied it is found that the buoyancy term in the vertical equation of motion is always the key in the calculations of the vertical motion. The results show that the growth rate of the downdraft is slow for large radius and fast for small radius. This is consistent with the theory of scale dependence.
Dissert. Abstr.

N90-29747# National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
METEOROLOGICAL CONDITIONS OVER THE NORTH ATLANTIC OCEAN DURING GCE/CASE/WATOX
B. J. B. Stunder, R. S. Artz, G. D. Rolph, J. F. Boatman, R. L. Gunter, J. M. Harris, and J. T. Merrill (Rhode Island Univ., Narragansett.) Jun. 1990 168 p
(PB90-252032; NOAA-TM-ERL-ARL-183) Avail: NTIS HC A08/MF A01 CSCL 04B

During the summer of 1988, a team of scientists aboard the NOAA ship Mt. Mitchell and the NOAA King Air aircraft investigated the spatial distributions of sulfur, nitrogen, and related species and their interactions during transport from North America. In support of these measurements, meteorological data from the National Meteorological Center and from rawinsonde data obtained from the ship were archived and back-trajectories were calculated. A summary of the meteorological conditions during the cruise is presented using synoptic maps, soundings, cross-sections and isobaric and isentropic back-trajectories. Since day-to-day variability of the synoptic situation was usually small, one representative day from each meteorological regime was chosen to illustrate the overall meteorology. During the cruise, three synoptic regimes were encountered: (1) north of the polar front, (2) the Bermuda/Azores High, and (3) the Intertropical Convergence Zone. Boundary layer depth and cloud layers were also estimated from all the soundings. GRA

N90-29748# Woods Hole Oceanographic Inst., MA.
IMPROVED METEOROLOGICAL MEASUREMENTS FROM BUOYS AND SHIPS (IMET): PRELIMINARY REPORT ON BAROMETRIC PRESSURE SENSORS
Richard E. Payne, Gennaro H. Crescenti, and Robert A. Weller Dec. 1989 47 p
(Grant NSF OCE-87-09614)
(PB90-242116; WHOI-89-49; IMET-TR-89-05) Avail: NTIS HC A03/MF A01 CSCL 04B

Stability tests over periods ranging from 3 to 19 months were carried out on Paroscientific models 215-AT and 760-15A, AIR DB-1A, Rosemount 1201F1B, Setra 270 and Heise 623 electronic barometers. The Paroscientific barometers had the highest accuracy, stability, and price, and the lowest power consumption. The Rosemount 1201F1B had excellent stability but high power consumption as well as price. The AIR DB-1A and Setra 270 have good stability and moderate power consumption and price. The tests are being expanded to include inexpensive sensors.
GRA

N90-29749# Air Force Geophysics Lab., Hanscom AFB, MA. Ionospheric Physics Div.
PRODUCTION OF NO, NO2 AND N2O IN AIR BY BREAKDOWN WITH HIGH POWER MICROWAVES: A PRELIMINARY REPORT Interim Scientific Report
Donald E. Hunton, John O. Ballenthin, Edmund Trzcinski, John F. Borghetti, and Gennaro S. Federico 5 Jan. 1990 39 p
(AF Proj. 2310)
(AD-A223297; GL-TR-90-0006; GL-ERP-1049) Avail: NTIS HC A03/MF A01 CSCL 07/2

Production of trace nitrogen oxide species in air discharge plasmas was observed with a quadrupole mass spectrometer attached to a specially-designed, S-band waveguide. At pressures between 25 and 200 Torr in the waveguide, nitric oxide (NO) was the most concentrated trace species observed, reaching concentrations of greater than 2 percent at 200 Torr. Nitrogen dioxide (NO2) was also observed, but only after the discharge had been turned off. NO2 concentrations were slightly lower than NO. At pressures between 9 and 0.3 Torr, the only species observed was nitrous oxide (N2O), which reached a concentration of approximately 2 percent at the lower pressure. The experimental apparatus, data collection procedures, calibration procedures, data reduction, and results are described in detail. GRA

N90-29750# Naval Research Lab., Washington, DC. Atmospheric Physics Branch.
TESTS OF INITIALIZATION PROCEDURES WITH THE NRL LIMITED AREA NUMERICAL WEATHER PREDICTION MODEL Memorandum Report
R. V. Madala and K. D. Sashegyi (Science Applications International Corp., McLean, VA.) 29 Jun. 1990 91 p Sponsored by ONR, Arlington, VA
(AD-A223549; NRL-MR-6648) Avail: NTIS HC A05/MF A01 CSCL 04/1

Several methods are tested to reduce the undesirable gravity wave oscillations in numerical integrations of NRL's Limited Area Weather Prediction model. The split-explicit temporal integration scheme used in the model is shown by itself to reduce the amplitude of the external gravity wave oscillations in the first six hours of integration. In a static non-linear initialization procedure, a diagnostic relation is derived for the geopotential on the sigma surfaces of the model. The procedure provides a balanced initial state, except for an initial adjustment of the vertical motion in the first five hours of integration. A vertical mode initialization procedure is also developed for the model. The scheme is tested on two grids. Convergence of the scheme is shown to be faster for the case of smoother topography along the lateral boundaries. Integrations with two different lateral boundary treatments are compared. The procedure is shown to prevent gravity wave oscillations without producing a mean drift in the surface pressure, to provide a balanced mass divergence, and to produce smaller changes to the initial mass and wind fields, compared to the static initialization. GRA

N90-29751# Reading Univ. (England).
COORDINATION OF MESOSCALE METEOROLOGICAL RESEARCH BETWEEN ASL AND EUROPEAN GROUPS Interim Report No. 2, 1 Apr. - 31 Jul. 1990
R. P. Pearce 31 Jul. 1990 14 p
(Contract DAJA45-90-C-0009)
(AD-A223811; R/D-6323-EN-01) Avail: NTIS HC A03/MF A01 CSCL 04/1

The main activity during this period was the Meeting of the European Mesometeorology panel along with members of Atmospheric Science Lab. (ASL) in Traben-Trarbach, West Germany. The report is presented of that meeting with its 10 recommendations. These all refer to the strengthening of the mesoscale modelling activity at ASL and exploitation of the data from the project WIND. The panel is most concerned that this most excellent data set be made available, as soon as possible, to the many mesoscale modelling groups in the U.S. and Europe in order that all can contribute to the development of mesoscale modelling at ASL for the benefit of the U.S. Army. GRA

N90-29752# Los Alamos National Lab., NM.
OBSERVATIONS OF TORNADOES AND WALL CLOUDS WITH A PORTABLE FM-CW DOPPLER RADAR: 1989–1990 RESULTS
H. B. Bluestein (Oklahoma Univ., Norman.) and W. P. Unruh 1990 5 p Presented at the 16th Conference on Severe Local Storms, Alta, Alberta, 22-26 Oct. 1990
(Contract W-7405-eng-36)
(DE90-013152; LA-UR-90-2161; CONF-9010120-1) Avail: NTIS HC A01/MF A01

The purpose of this paper is to report on our progress using a portable, 1 W, FM (frequency modulated)-CW (continuous wave) Doppler radar developed at the Los Alamos National Laboratory (LANL), to make measurements of the wind field in tornadoes and wall clouds along with simultaneous visual documentation. Results using a CW version of the radar in 1987 to 1988 are given in Bluestein and Unruh (1989). DOE

N90-29753# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Meteorologische Flugmessysteme.
A DOCUMENTATION OF ICING-RELEVANT CLOUD PHYSICAL PARAMETERS ON VERTICAL SOUNDINGS OF STRATIFORM CLOUDS
Hans-Eberhard Hoffmann, Johann Demmel, Herbert Horst, and Heinz Loebel 1990 148 p In GERMAN; ENGLISH summary
(DLR-Mitt-90-07; ISSN-0176-7739; ETN-90-97541) Avail: NTIS HC A07/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Rep. of Germany, HC 53 deutsche marks

From 1984 to 1988, 33 soundings over southern Germany were made according to the types of clouds in relation to high and low pressure areas, cold and warm fronts and west to north flow without marked pressure area or front. It was concluded, that in Sc and St cloudiness of a high pressure area, without precipitation on the ground, the total water content increases approximately continuously with growing distance from the cloud base and has its maximum in the upper third of the cloud. The median volume diameter has generally small values, except in the lower and upper area of the cloud. In the case of a cold or warm front or in a west to north flow, these maximum values vary strongly and are located in different areas of height. ESA

N90-29754# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Meteorologische Fernerkundung.
THE SKIN TEMPERATURE OF MOUNTAIN SLOPES AND THE DETERMINATION OF THE SENSIBLE HEAT FLUX Ph.D. Thesis - Ludwig-Maximilian-Univ.
Hermann Mannstein 1990 130 p In GERMAN; ENGLISH summary
(Contract BMFT-KF-3009/2)
(DLR-FB-90-07; ISSN-0171-1342; ETN-90-97545) Avail: NTIS HC A07/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Rep. of Germany, HC 45.50 DM

Remotely sensed surface temperatures and airborne measurements of temperature profiles in the alpine region were used to derive the sensible heat flux from slopes into the atmosphere. As the Advanced Very High Resolution Radiometer (AVHRR) onboard the satellites of the National Oceanic and Atmospheric Administration series gives only a coarse spatial resolution compared to the variation of the alpine relief, new techniques were developed for application of these data even in the sub-pixel range. The atmospheric correction was calculated as a function of the ground height with a radiation transfer model which allows the estimation of the atmospheric absorption and emission by the temperature and moisture profiles. The most important factor is the difference between surface and air temperature at the same altitude. ESA

N90-29755# Norwegian Defence Research Establishment, Kjeller.
DETECTION AND ANALYSIS OF WIND FRONTS AND CURRENT SHEAR IN DIGITAL SAR IMAGES

Anne Helene Schistad 25 Oct. 1989 122 p In NORWEGIAN; ENGLISH summary
(FFI-89/7016; ISSN-0802-2437; ETN-90-97617) Avail: NTIS HC A06/MF A01

Various methods for automatic detection and description of wind fronts and current shears, two geophysical phenomena often visible in Synthetic Aperture Radar (SAR) images, are described. The methods rely heavily on a priori knowledge of speckle statistics. They are tested on SAR images from the satellite Seasat. An experimental system for detection of wind fronts and current shears was implemented on a SUN-3 workstation. ESA

N90-29756 Danish Meteorological Inst., Copenhagen. Div. of Geophysics.
BRORFELDE GEOMAGNETIC OBSERVATORY: MAGNETIC RESULTS, 1987
1989 43 p
(ISBN-87-7478-297-5; ETN-90-97618) Avail: Danish Meteorological Inst., Lyngbyvej 100, 2100 Copenhagen, Denmark

The geographical and geomagnetic coordinates are given. The instrumental equipment, principally the regular recording of three geomagnetic elements by means of a home made digitally recording magnetometer system, is described. The determination of the reduction formulas and baseline values is discussed and the formulas are given. The quality and accuracy of the data are discussed. Tables of horizontal intensity, declination, and vertical intensity hourly mean values are presented. Summaries and annual mean values are given. ESA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N90-29757 California Univ., San Diego.
SOME ASPECTS OF THE STRUCTURE AND EVOLUTION OF OCEANIC SPREADING CENTERS Ph.D. Thesis
David William Caress 1989 139 p
Avail: Univ. Microfilms Order No. DA9013652

Sea Beam and magnetics data are analyzed from an area north of the Mendocino fracture zone where a change in the direction of seafloor spreading occurred about 55 Ma. Finding evidence for propagation episodes accounting for the reorientation of 75 percent of the ridge system, it is concluded that the primary mechanism of the reorganization was rift propagation. A tectonic evolution model of the reorganization is presented which fits the data well using 11 propagation episodes. A statistical algorithm for interpolation and downward continuation of magnetic anomaly data is presented. It is assumed that the magnetic anomaly is a realization of a random stationary field whose power spectral density (PSD) can be estimated; by using the PSD the algorithm produces an array incorporating as much of the information contained in the data as possible while avoiding the introduction of unnecessary complexity. The algorithm has the added advantage of estimating the uncertainty of every interpolated value. Downward continuation is a natural extension of the statistical algorithm. The method is applied to the interpolation of magnetic anomalies from the region around the 95.5 deg W Galapagos propagating rift and also to the downward continuation of these data. The 2320 P-wave travel times are inverted from a seismic refraction experiment at 12 deg 50 min N on the East Pacific Rise (EPR) for the two dimensional crustal seismic velocity structure across the EPR axis. A 7 km wide zone beneath the rise axis is resolved in which the velocity is reduced by 0.5 to 1.0 km/sec. The upper crustal velocity variations are attributed to changes in porosity due to faulting and hydrothermal alteration. The small velocity reductions of the LVZ are consistent with hot rock near the solidus which contains a small or negligible quantity of melt. Dissert. Abstr.

N90-29758# Massachusetts Inst. of Tech., Cambridge.
RATES OF VERTICAL MIXING, GAS EXCHANGE, AND NEW PRODUCTIONS: ESTIMATES FROM SEASONAL GAS CYCLES IN THE UPPER OCEAN NEAR BERMUDA Ph.D. Thesis
William Seth Spitzer Aug. 1989 164 p Prepared in cooperation with Woods Hole Oceanographic Inst., MA
(Grant NSF OCE-85-01171)
(PB90-244781; WHOI-89-30) Avail: NTIS HC A08/MF A01 CSCL 08C

Argon measurements, obtained from three years of monthly detailed vertical profiles near Bermuda (Station S, 32 deg N 64 deg W), show a maximum in argon supersaturation of about 4 percent in the seasonal thermocline in late summer. Since the argon supersaturation is 3 to 4 times smaller than that of oxygen, most of the oxygen supersaturation is not of physical origin and hence must result from biological production. In the winter mixed layer, air injection produces argon supersaturation despite high gas exchange rates. During spring and summer, radiative heating, air injection, and an upward argon flux create an even larger supersaturation in the mixed layer. In the seasonal thermocline, radiative heating creates argon supersaturations that persist in spite of vertical mixing. The observed seasonal cycles of temperature, argon, helium, and oxygen are simulated with an upper ocean model. The author linearizes the model's response to variations in vertical diffusivity, air injection, gas exchange rate, and new production and then uses an inverse technique (singular value decomposition) to determine the values of these parameters that best fit the data. Author

N90-29759# California Inst. of Tech., Pasadena. Dept. of Applied Mathematics
RESEARCH IN NONLINEAR WATER WAVES Quarterly Progress Report, 1 Apr. - 30 Jun. 1990
Philip G. Saffman 2 Jul. 1990 2 p
(Contract N00014-89-J-1164)
(AD-A224065) Avail: NTIS HC A01/MF A01 CSCL 08/3

The study of finite amplitude waves and wave instabilities in the presence of a thin wind drift layer has continued. With regard to finite amplitude waves, the formulation of the problem in terms of integral equations for the surface shape, which will allow steep (or even overhanging) waves to be calculated, was completed. The remaining task is to settle the counting issue, i.e., ensure that the number of waves is equal to the number of unknowns, which is proving to be a difficult and tricky problem, and then the calculation of the wave shapes will begin. GRA

N90-29760 Royal Netherlands Meteorological Inst., De Bilt. Div. of Oceanographical Research.
THE EFFECT OF WAVE DATA ASSIMILATION ON THE NUMERICAL SIMULATION OF WAVE ENERGY ADVECTION
Miriam deLasHeras and Gerrit Burgers 1990 42 p Sponsored by Ministry of Public Affairs, Madrid, Spain
(KNMI-TR-121; ISSN-0169-1708; ETN-90-97650) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, Netherlands

Simulated observations are assimilated into a simple wave model, in which only propagation is considered. The approach used to assimilate them is called 'model fitting'. It looks for the solution of the model equations which fits best the observations to the space-time domain being considered. It is also required that the deviation from a priori knowledge (in this case the model initial state) remains as small as possible, in some well specified sense. The method is based on the minimization of a so called 'cost function', which is a quadratic function of the differences between modeled data and observations on the one hand, and between modeled and a priori data on the other hand. The minimization of the cost function is done by means of an iterative gradient based descent method. After assimilation, new model results, which fit better to the observations and prior knowledge considered, are produced. The data assimilation process is concluded to improve the wave field, but its effect is more clearly noticed around the observations than elsewhere, and it does not remain long after stopping assimilating. ESA

51 LIFE SCIENCES (GENERAL)

N90-29761*# Harvard Medical School, Boston, MA. Dept. of Physiology.
RENAL RESPONSE TO SEVEN DAYS OF LOWER BODY POSITIVE PRESSURE IN THE SQUIRREL MONKEY
Susanne Churchill, David M. Pollock, Mary Ellen Natale, and Martin C. Moore-Ede [1987] 30 p Prepared in cooperation with Institute for Circadian Physiology, Boston, MA
(Contract NAS2-10547)
(NASA-CR-183355; NAS 1.26:183355) Avail: NTIS HC A03/MF A01 CSCL 06C

As a ground-based model for weightlessness, the response of the chair-trained squirrel monkey to lower body positive pressure (LBPP) was evaluated in a length of study similar to a typical Space Shuttle mission (7 days). Results were compared to time control experiments that included chair-sitting without exposure to LBPP. Chronic exposure to LBPP results in an acute diuretic and natriuretic response independent of changes in plasma aldosterone concentrations and produces a chronic reduction in fluid volume lasting the duration in the stimulus. Author

N90-29762# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
20 Jun. 1990 27 p
(JPRS-ULS-90-007) Avail: NTIS HC A03/MF A01

Abstracts of Soviet literature in various areas of the life sciences are compiled. The following subject areas are covered: aerospace medicine, biochemistry and biotechnology, epidemiology and immunology, military medicine, pharmacology and toxicology, and radiation biology. M.G.

N90-29763# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
23 Apr. 1990 39 p
(JPRS-ULS-90-004) Avail: NTIS HC A03/MF A01

Abstracts of Soviet literature in various areas of the life sciences are compiled. The following subject areas are covered: agricultural science, biochemistry, genetics, medicine, microbiology, pharmacology and toxicology, physiology, and public health. M.G.

N90-29764# Institute for Circadian Physiology, Boston, MA.
PHARMACOLOGICAL RESETTING OF THE CIRCADIAN SLEEP-WAKE CYCLE EFFECTS OF TRIAZOLAM ON REENTRAINMENT OF CIRCADIAN RHYTHMS IN A DIURNAL PRIMATE Final Technical Report, 1 May - 31 Oct. 1990
Z. Boulos and M. C. Moore-Ede 12 Jun. 1990 12 p
(Grant AF-AFOSR-0191-88; AF Proj. 2312)
(AD-A224227; AFOSR-90-0755TR) Avail: NTIS HC A03/MF A01 CSCL 06/5

An attempt was made to accelerate the reentrainment of circadian rhythms in squirrel monkeys exposed to 8-hr phase advances and phase delays of the daily light-dark cycle by timed administration of the short acting benzodiazepine, triazolam. On the day of the phase advance, each animal received a single injection of triazolam (0.3 mg) or of vehicle alone in mid-subjective day, 2 hr after the new time of dark onset, while on the day of the phase delay, the animals received triazolam or vehicle in late subjective night, just before dark onset. The daily acrophases of the circadian rhythm of body temperature were calculated by cosinor analysis, and exponential functions were fitted to the acrophases that followed each of the phase shifts. The rates of reentrainment, defined as the time required for the exponential functions to reach 90 percent of their asymptotic values, were slower after the phase advance than after the phase delay but did not differ significantly between drug and vehicle conditions. GRA

N90-29765# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
INTERACTION OF ELECTROMAGNETIC FIELDS WITH CHONDROCYTES IN GEL CULTURE Final Report, 1 Feb. - 22 Aug. 1989
Alan J. Grodzinsky, Yehezkiel A. Gluzband, and Michael D. Buschmann Feb. 1990 32 p
(Contract F33615-87-D-0626; AF Proj. 2312)
(AD-A223397; USAFSAM-TR-89-27) Avail: NTIS HC A03/MF A01 CSCL 06/4

The research accomplished during this project period focused on control experiments designed to establish whether cartilage cells from normal cartilage will continue to synthesize and accumulate normal extracellular matrix in agarose gel culture. This information is essential to properly design experiments to qualify changes in chondrocyte biosynthesis due to applied electromagnetic fields. The results suggest that both normal chondrocytes and swarm rat chondrosarcoma cells in agarose culture can continue to synthesize matrix macromolecules at a rate similar to or slightly higher than that in normal cartilage; also, that chondrocytes in agarose can successfully mediate assembly and accumulation of normal, mechanically functional extracellular matrix. GRA

N90-29766# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Weltraumbiologie.
EXOGENOUS AND ENDOGENOUS CONTROL OF ACTIVITY BEHAVIOR AND THE FITNESS OF FISH Thesis - Cologne Univ.
Dieter Seibt 1990 161 p In GERMAN; ENGLISH summary Report will be announced as translation (ESA-TT-1221)
(DLR-FB-90-14; ISSN-0171-1342; ETN-90-97546) Avail: NTIS HC A08/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Rep. of Germany, HC 48 deutsche marks

The variations of the locomotive activity of the goldfish under light direction and intensity are studied. The fish were first studied in standardized conditions and were then fed at irregular intervals. An alternation light shadow cycles of variable lengths shows the influence of exogenous factors on activity. The dorsal light reaction of guppy was used for a fitness and performance test: a vertical aligning of the fish separated the light direction from the gravity orientation. Quality, precision and velocity of the orientation reactions after changes of the lighting angle were measured and examined for periodical variations. ESA

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N90-29767# Naval Aerospace Medical Research Lab., Pensacola, FL.
VESTIBULAR RESPONSES AND MOTION SICKNESS DURING PITCH, ROLL, AND YAW SINUSOIDAL WHOLE-BODY OSCILLATION Interim Report
F. E. Guedry, J. Norman, G. Turnipseed, and A. Rupert Mar. 1990 16 p
(AD-A223898; NAMRL-1352) Avail: NTIS HC A03/MF A01 CSCL 06/10

The vestibulo-ocular reflex and motion sickness were evaluated in 5 groups of 15 men during low frequency sinusoidal whole-body oscillation about an earth-vertical axis. Head and body configurations differed between groups so that the amount of vertical canal stimulation received was varied over groups. Significant differences were found for the long time constant of the vestibulo-ocular reflex between pitch- and roll-axis stimuli. The long constant is short for the pitch axis, intermediate for the roll axis, and long for the yaw axis. Motion sickness appeared to be related to the amount of vertical semicircular canal simulation received, with no clear difference between roll-axis and pitch-axis groups. GRA

N90-29768# Texas Univ., San Antonio.
MULTI-USER FACILITY FOR HIGH PERFORMANCE OPTICAL RECORDING OF BRAIN ACTIVITY (DURIP) Final Report, 1 Dec. 1988 - 30 Nov. 1989
David M. Senseman 1 Jun. 1990 9 p
(Grant AF-AFOSR-0118-89; AF Proj. 3842)
(AD-A223491; AFOSR-90-0683TR) Avail: NTIS HC A02/MF A01 CSCL 15/5

This equipment grant provided funds to purchase a Silicon Graphics workstation for optical recording of brain activity. The system is being used by scientists at the University of Texas and the USAF School of Aerospace Medicine to examine brain electrical activity related to aerospace environmental stresses. GRA

N90-29769# Minnesota Univ., Duluth.
EVALUATION OF PHYSIOLOGICAL AND PSYCHOLOGICAL IMPAIRMENT OF HUMAN PERFORMANCE IN COLD STRESSED SUBJECTS Midterm Report, 9 May 1988 - 8 Nov. 1989
L. E. Wittmers and Richard G. Hoffman 23 Mar. 1990 170 p
(Contract DAMD17-88-C-8054; DA Proj. 3E1-62787-A-879)
(AD-A223635) Avail: NTIS HC A08/MF A01 CSCL 06/5

The data presented here deals with the physiological and psychological responses of man (13 subjects) to cold exposure (0 C) and added stresses. The additional stresses included cold water (15 C-mid thigh), sleep deprivation (24 hr) and exercise (70 precent maximum heart rate). Cardiovascular and respiratory parameters were monitored throughout the experiments. Urinary catecholamine excretion was determined to estimate stress levels. Skin and rectal temperatures were continuously monitored to evaluate temperature regulation. EMG monitoring was used to study the onset, pattern and magnitude of shivering in seven muscle groups. Four methods for short term shiver suppression were evaluated under the five experimental protocols. Cognitive function and rifle shooting performance were evaluated. Shooting performance and cognitive function were not significantly affected by additional stressors. GRA

N90-29770# Naval Health Research Center, San Diego, CA. Dept. of Sleep Research.
MINIMAL SLEEP TO MAINTAIN PERFORMANCE: SEARCH FOR SLEEP QUANTUM IN SUSTAINED OPERATIONS Interim Report
Paul Naitoh 30 Nov. 1989 29 p Sponsored by Naval Research and Development Command, Bethesda, MD
(AD-A223815; NHRC-89-49) Avail: NTIS HC A03/MF A01 CSCL 06/4

In many civilian and military occupations, personnel are required to work on a job until it is completed, even if such requirements demand continuous work for a period longer than 24 hours and/or irregular work under irregular schedules, so that sleep becomes too disrupted and too short to allow the worker to recuperate from daily fatigue. The disruption of sleep results in the worker's reduced productivity and increased risks of error or injury at work sites. In this paper, applications of sleep management are proposed to minimize degradation in work performance and to improve job safety. The basic knowledge of sleep management is discussed in detail, supplementing a sleep management guideline previously published (Naitoh, Englund and Ryman, 1986). Some of the key questions of sleep management are to determine minimal sleep duration, to evaluate impact of time of day when sleep is taken on recuperative power of sleep, and to measure individual differences in sleep habits. GRA

N90-29771# Naval Health Research Center, San Diego, CA.
OPTIMISM AND CARDIOVASCULAR REACTIVITY TO PSYCHOLOGICAL AND COLD PRESSOR STRESS Final Report
C. N. Leake, A. W. Langer (Syracuse Univ., NY.), C. E. Englund, and M. Sinclair 27 Dec. 1989 19 p Sponsored by Naval Medical Research and Development Command, Bethesda, MD
(AD-A223818; NHRC-89-53) Avail: NTIS HC A03/MF A01 CSCL 06/4

The relationship between optimism, as measured by the Life Orientation Test (LOT), and the response to mental arithmetic (MA) and cold pressor (CP) stressors was examined in 35 men. Reactivity measurements included heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure, oxygen consumption (V), minute ventilation (VE), and plasma (CORT). In order to clarify the importance of optimism to reactivity, additional assessments were made for hostility, depression, behavior type, and trait anger and anxiety. Both stressors elicited significant cardiovascular, pulmonary and cortisol responses (P less than 0.005) with the magnitude of response being greater for the CP task. Significant Pearson Correlations were found between LOT and CP reactivity for VE (r = .285, P less than 0.05), and MA reactivity for HR (r = .281, P less than 0.05) and VE (r = .374, P less than 0.01) yet the results suggest that optimism was not strongly associated to reactivity elicited by either stressor. However, results did indicate that the relationship between optimism and cardiovascular reactivity may be as important as those exhibited by other psychological parameters. GRA

N90-29772# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
FREQUENCY AND VENTILATION: A SURVEY OF THEORETICAL AND EXPERIMENTAL VENTILATION MODELLING
F. H. C. deJongh Apr. 1990 46 p
(LR-625; ETN-90-97636) Avail: NTIS HC A03/MF A01

The establishment of a relation between ventilation efficiency and frequency is a final goal. A first step in this process is the construction of a lung model. The lung model contains many material, geometrical and flow parameters. Obviously a simple model is preferred. Therefore some insight in the influence of the various material, geometrical and flow parameters in the lung model on the output quantities has to be obtained. In order to get this insight a computer program is constructed to analyze the influence of the various parameters in a human lung. The output quantities are for instance: concentration of the different gases, pressure drop across the bronchii, flow velocities and diffusion rates. The conditions to be analyzed are normal ventilation, maximum expiration and high frequency ventilation occurring in human beings in the range from early born infants to adults. A survey of existing lung models for the different aspects of respiration to be studied, is given. The applicability in the computer program is emphasized. ESA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N90-29773# Naval Health Research Center, San Diego, CA. Operational Performance Dept.
COPING STRATEGIES AND MOOD DURING COLD WEATHER TRAINING Interim Report
Ross R. Vickers, Jr., David W. Kolar, and Dennis L. Kelleher 20 Dec. 1989 19 p
(AD-A223915; NHRC-89-47) Avail: NTIS HC A03/MF A01 CSCL 05/8

Adverse emotional reactions are a recognized problem in cold weather operations. The hypothesis that these reactions are related to coping strategies employed in the cold was tested. The coping strategies and emotional status of men going through winter cold weather training were compared to those of men going through summer mountain warfare training. The men going through cold weather training reported higher levels of depressed mood, anger, and anxiety and lower levels of happiness and activity. These men also reported more frequent thoughts about other times and places as a means of coping. Coping strategies were moderately strong predictors of mood during both the winter and summer training programs, and analyses of covariance controlling for the group differences in coping by escapist thinking showed that this

difference could account for the observed group differences in mood. The study confirmed that coping strategies are related to adverse emotional reactions in cold weather settings. Additional research to identify the specific factors in cold weather training that elicit maladaptive coping could help develop programs to foster positive coping. GRA

N90-29774# California Univ., Berkeley. Dept. of Psychology.
NORMS AND PERCEPTION OF EVENTS Annual Technical Report No 2, 1 Jul. 1989 - 15 Jun. 1990
Daniel Kahneman 15 Jun. 1990 36 p
(Grant AF-AFOSR-0206-89; AF Proj. 2313)
(AD-A224236; AFOSR-90-0760TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

A study of contingent coding in normality judgements yielded disappointing results. A systematic exploration was started of the relation between discriminability and similarity, which will be extended to categorization and normality. A series of studies established essentially perfect dimensional independence in object-specific priming. A theoretical and empirical examination was conducted of close counterfactuals. Two separate projects dealt with the process of comparison, continuing and extending work reported last year. GRA

N90-29775# New York Univ., New York. Neuromagnetism Lab.
ATTENTION, IMAGERY, AND MEMORY: A NEUROMAGNETIC INVESTIGATION Annual Technical Report, 1 Mar. 1989 - 28 Feb. 1990
Lloyd Kaufman and Samuel J. Williamson 15 May 1990 8 p
(Contract F49620-88-K-0004; AF Proj. 2313)
(AD-A224560; TR-90-1; AFOSR-90-0779TR) Avail: NTIS HC A02/MF A01 CSCL 05/8

This report describes work on mental imagery, short term memory scanning, language-related mental tasks, and visual attention. In the field of mental imagery it was found that searching memory to determine if or if not a visual form had been seen before, there is a change in the state of the occipital (visual) cortex. This change is commensurate in time with the reaction time indicating that the mental search is complete. It was also shown that engaging in language related tasks does not have a similar effect on visual cortex, but it does have a similar effect on temporal cortex. Using visually presented words to initiate a mental imaging task results in related changes in activity of visual cortex, and also temporal cortex. However, when the same words are used in rhyming tasks, the major effect is on left temporal cortex. Using acoustically presented words in a similar task produces parallel results, although the effects on visual cortex are not so reliability found across subjects, and both imaging and rhyming affect temporal cortex, suggesting a role for language in imagery. In another memory scanning experiment subjects attempted to determine if a musical note was or was not a member of a set of previously heard notes. The duration of the change in brain state, implied by suppression of alpha band activity, was related to the size of the memory set, provided that it was recorded in a region that picked up activity originating in temporal areas, probably auditory cortex. GRA

N90-29776# Minnesota Univ., Minneapolis. Dept. of Psychology.
ABILITY AND METACOGNITIVE DETERMINANTS OF SKILL ACQUISITION AND TRANSFER Final Report, 1 Jan. 1989 - 30 Apr. 1990
Ruth Kanfer and Phillip L. Ackerman 30 Jun. 1990 91 p
(Grant AF-AFOSR-0242-89; AF Proj. 2313)
(AD-A224569; AFOSR-90-0783TR) Avail: NTIS HC A05/MF A01 CSCL 05/8

This report reviews a theoretical framework and empirical research concerning the interactions between cognitive abilities (both general intellectual and perceptual speed) and self-regulatory/metacognitive processes (including emotion control and motivation control) during complex skill acquisition. The framework outlines how ability and metacognitive strategies affect attention and cognitive effort as determinants of individual and group differences in task performance during skill acquisition. Specifically, the self-regulatory strategy of emotion control affects task performance early in skill acquisition, when strategy of emotion control affects task performance early in skill acquisition, when attentional resource demands are diminished. Individual differences in general ability interact with the dynamic attentional demands of complex tasks during training, and thus further interact with the influence of these two self-regulatory strategies. Two experiments delineating the interactive effects of training for emotion control and motivation control were conducted, with a criterion air traffic controller simulation task. GRA

N90-29777*# Illinois Univ., Champaign.
PHYSIOLOGICAL METRICS OF MENTAL WORKLOAD: A REVIEW OF RECENT PROGRESS Interim Report, 1 Jan. - 1 Oct. 1989
Arthur F. Kramer Jun. 1990 58 p Submitted for publication
Sponsored in part by Office of Naval Technology, Arlington, VA
(Grant NAG2-308)
(NASA-CR-187290; NAS 1.26:187290; AD-A223701; NPRDC-TN-90-23) Avail: NTIS HC A04/MF A01 CSCL 06/4

This report reviews research on physiological metrics of mental workload performed in the last decade. The focus of the review is on measurement techniques that have potential for fundamental explanation of mental workload and for use in operational environments. The techniques are examined within a framework of measurement criteria. These criteria include: sensitivity, diagnosticity, intrusiveness, reliability, and generality of application. Over 200 articles are covered by the review. Measures reviewed include: electroencephalograms, event-related potentials, magnetoencephalograms, positron emission tomography, electro-oculograms, cardiovascular measures, pupilometry, respiratory measures, and electrodetmal measures. GRA

N90-29778# Los Alamos National Lab., NM.
QTA (QUESTIONNAIRE-TASK-ANALYSIS): AN ELECTRONIC TOOL FOR JOB/TASK ANALYSIS
F. Kay Houghton and R. Jay Fries 1990 5 p Presented at the Association for the Development of Computer-based Instruction Systems (ADCIS) Meeting, San Diego, CA, 29 Oct. - 1 Nov. 1990
(Contract W-7405-eng-36)
(DE90-008944; LA-UR-90-776; CONF-901055-1) Avail: NTIS HC A01/MF A01

When a computer-based training (CBT) package is part of a performance-based training system, a job/task analysis (JTA) to identify and document training requirements is the first step. To identify and document training requirements, performance-based training mandates that a job/task analysis be completed. To simplify the task of performing the job/task analysis for the control room operators at the plutonium facility at Los Alamos National laboratory, we wrote the MODULA-2 program QUESTIONNAIRE-TASK-ANALYSIS (QTA). Because we were performing the job/task analysis to meet the requirements of DOE Order 5480.18, the programming was based on the documentation presented in the DOE documents Training Accreditation Program Manuals (TAP 1, TAP 2, and TAP 3). The model for the questionnaire portion of the program was Attachment I-8, page I-33, of TAP 2-88. The analysis that recommends no-train, train or overtrain uses the decision tree on page I-10 of TAP 2-88. However, the program is useful beyond just compliance with the Order. The program performs two functions: it collects numerical data from a questionnaire with a rating scale, and it analyzes the data. After the data are collected, the analysis portion uses a decision tree to make training recommendations. The data may be collected using a long form or a short form of the questionnaire. The analysis procedure creates three analysis files based on job classifications of the respondents. Because of the dual capabilities of the program, QTA may be used by a respondent to complete the questionnaire or the analyst to analyze the results of the survey. Before discussing the QTA program in detail, we will briefly review the process of performing a job task analysis. DOE

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N90-29779# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.

A HUMAN FACTORS ENGINEERING APPROACH TO THE DEVELOPMENT AND DYNAMIC EVALUATION OF A PROTOTYPE AIRCREW SEAT FOR MILITARY AIRCRAFT

Ph.D. Thesis - Texas A&M College

James David Whiteley Dec. 1988 228 p

(AD-A218283; AFIT/CI/CIA-89-008) Avail: NTIS HC A11/MF A02 CSCL 05/8

The results are presented of an investigation which constrasted the currently available C-130 aircrew seat with two custom made prototype modified C-130 aircrew seats. Twelve active duty AF males participated in a series of dynamic vibration exposure tests which simulated the actual flying environment. Performance tasks, subjective surveys, spinal creep measurements, and seat pain pressure measurements were accomplished. Analysis of variance were performed on data collected. Both buttock and thigh discomfort proved to be statistically responsive to seat type. In each instance, the current seat was rated as causing far more pain and discomfort that the other seats. Author

N90-29780*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PROCEEDINGS OF THE NASA CONFERENCE ON SPACE TELEROBOTICS, VOLUME 3

Guillermo Rodriguez, ed. and Homayoun Seraji, ed. 31 Jan. 1989 541 p Conference held in Pasadena, CA, 31 Jan. - 2 Feb. 1989

(Contract NAS7-918)

(NASA-CR-186858; JPL-Publ-89-7-Vol-3; NAS 1.26:186858)

Avail: NTIS HC A23/MF A04 CSCL 05H

The theme of the Conference was man-machine collaboration in space. The Conference provided a forum for researchers and engineers to exchange ideas on the research and development required for application of telerobotics technology to the space systems planned for the 1990s and beyond. The Conference: (1) provided a view of current NASA telerobotic research and development; (2) stimulated technical exchange on man-machine systems, manipulator control, machine sensing, machine intelligence, concurrent computation, and system architectures; and (3) identified important unsolved problems of current interest which can be dealt with by future research. For individual titles, see N90-29781 through N90-29829.

N90-29781*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE FLIGHT TELEROBOTIC SERVICER: NASA'S FIRST OPERATIONAL SPACE ROBOT

Charles F. Fuechsel *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 3-7 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

Alternatives to the exploration of Mars by direct human presence are under consideration by both the United States and the Soviet Union. In these concepts, autonomous surface vehicles would navigate the planet performing a variety of detailed exploratory functions such as mapping, seismic measurements, sample collection and analysis. Both of these approaches to the exploration of Mars depend to a high degree on the ability of robotic machinery to perform complex functions without real time human direction. Closer to home and in time, robotics will begin to play a role in space operations in the construction and maintenance of Space Station Freedom. The Flight Telerobotic Servicer Project is introduced as an element of the Space Station Freedom, and its objectives and some special challenges it faces are discussed. Author

N90-29782*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.

MODELING, DESIGN, AND CONTROL OF FLEXIBLE MANIPULATOR ARMS: STATUS AND TRENDS

Wayne J. Book *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 11-24 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

The desire for higher performance manipulators has lead to dynamic behavior in which the flexibility is an essential aspect. The mathematical representations commonly used in modeling flexible arms and arms with flexible drives are examined first. Then design considerations directly arising from the flexible nature of the arm are discussed. Finally, controls of joints for general and tip motion are discussed. Author

N90-29783*# Lockheed Engineering and Sciences Co., Houston, TX.

DYNAMICAL MODELING OF SERIAL MANIPULATORS WITH FLEXIBLE LINKS AND JOINTS USING THE METHOD OF KINEMATIC INFLUENCE

Philip L. Graves *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 25-34 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

A method of formulating the dynamical equations of a flexible, serial manipulator is presented, using the Method of Kinematic Influence. The resulting equations account for rigid body motion, structural motion due to link and joint flexibilities, and the coupling between these two motions. Nonlinear inertial loads are included in the equations. A finite order mode summation method is used to model flexibilities. The structural data may be obtained from experimental, finite element, or analytical methods. Nonlinear flexibilities may be included in the model. Author

N90-29784*# Toshiba Corp., Kawasaki (Japan).

CAPTURE OF FREE-FLYING PAYLOADS WITH FLEXIBLE SPACE MANIPULATORS

T. Komatsu, M. Uenohara, S. Iikura, H. Miura, and I. Shimoyama (Tokyo Univ., Japan) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 35-44 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

A recently developed control system for capturing free-flying payloads with flexible manipulators is discussed. Three essential points in this control system are, calculating optimal path, using a vision sensor for an external sensor, and controlling active vibration. Experimental results are shown using a planar flexible manipulator. Author

N90-29785*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.

TECHNOLOGY AND TASK PARAMETERS RELATING TO THE EFFECTIVENESS OF THE BRACING STRATEGY

Wayne J. Book and J. J. Wang *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 45-58 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

The bracing strategy has been proposed in various forms as a way to improve robot performance. One version of the strategy employs independent stages of motion. The first stage, referred to as the large or bracing arm, carries the second stage of motion. After the first stage has completed its motion it is braced to provide a more rigid base of motion with a more accurate relationship to the parts to be manipulated. The hypothesis is that more rapid

completion of certain tasks is possible with lighter arms using the bracing strategy. While it is easy to make conceptual arguments why this should be so, it is less easy to specify even approximately when this will be true for some reasonably generic situation. There is no relevant experience base with bracing arms to be compared to non-bracing arms. Furthermore, if one were interested in obtaining such practical experience, there would be no methodical guidance on the selection of an interesting case, one in which the unproven approach, bracing, can show its superiority. If one such case exists, only the extent of applicability of the new approach is in question. One set of interesting cases is likely to be applications in which a large workspace must be covered, but where a series of small accurate moves will remain within a smaller region of the total workspace. A prototype application with these characteristics is set up and a skeleton design of arms using the competing strategies are compared. Author

N90-29786*# Tokyo Univ. (Japan). Dept. of Mechanical Engineering.

MANIPULATORS WITH FLEXIBLE LINKS: A SIMPLE MODEL AND EXPERIMENTS

Isao Shimoyama and Irving J. Oppenheim (Carnegie-Mellon Univ., Pittsburgh, PA.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 59-68 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

A simple dynamic model proposed for flexible links is briefly reviewed and experimental control results are presented for different flexible systems. A simple dynamic model is useful for rapid prototyping of manipulators and their control systems, for possible application to manipulator design decisions, and for real time computation as might be applied in model based or feedforward control. Such a model is proposed, with the further advantage that clear physical arguments and explanations can be associated with its simplifying features and with its resulting analytical properties. The model is mathematically equivalent to Rayleigh's method. Taking the example of planar bending, the approach originates in its choice of two amplitude variables, typically chosen as the link end rotations referenced to the chord (or the tangent) motion of the link. This particular choice is key in establishing the advantageous features of the model, and it was used to support the series of experiments reported. Author

N90-29787*# Ohio State Univ., Columbus. Dept. of Electrical Engineering.

EXPERIMENTS IN IDENTIFICATION AND CONTROL OF FLEXIBLE-LINK MANIPULATORS

Stephen Yurkovich, Anthony P. Tzes, and Fernando E. Pacheco *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 69-78 (For primary document see N90-29780 24-54)

(Grant NAG1-720)

Avail: NTIS HC A23/MF A04 CSCL 05H

Interest in the study of flexible-link manipulators for space-based applications has risen strongly in recent years. Moreover, numerous experimental results have appeared for the various problems in the modeling, identification and control of such systems. Nevertheless, relatively little literature has appeared involving laboratory verification of tuning controllers for certain types of realistic flexible-link manipulators. Specifically flexible-ink manipulators which are required to maintain endpoint accuracy while manipulating loads that are possibly unknown and varying as they undergo disturbance effects from the environment and workspace. Endpoint position control of flexible-link manipulators in these areas are discussed, with laboratory setups consisting of one and two-link manipulators. Author

N90-29788*# University of Southern California, Los Angeles. Dept. of Computer Science.

AUTONOMOUS DEXTEROUS END-EFFECTORS FOR SPACE ROBOTICS

George A. Bekey, Thea Iberall, and Huan Liu *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 81-88 (For primary document see N90-29780 24-54)

(Contract JPL-956501; NSF DMC-87-19579; NSF IRI-87-96249)

Avail: NTIS HC A23/MF A04 CSCL 05H

The development of a knowledge-based controller is summarized for the Belgrade/USC robot hand, a five-fingered end effector, designed for maximum autonomy. The biological principles of the hand and its architecture are presented. The conceptual and software aspects of the grasp selection system are discussed, including both the effects of the geometry of the target object and the task to be performed. Some current research issues are presented. Author

N90-29789*# Louvain Univ. (Belgium). Dept. of Mechanical Engineering.

DESIGN AND CONTROL OF A MULTI-FINGERED ROBOT HAND PROVIDED WITH TACTILE FEEDBACK

H. VanBrussel, B. Santoso, and D. Reynaerts *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 89-101 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

The design, construction, control and application of a three fingered robot hand with nine degrees of freedom and built-in multi-component force sensors is described. The adopted gripper kinematics are justified and optimized with respect to grasping and manipulation flexibility. The hand was constructed with miniature motor drive systems imbedded into the fingers. The control is hierarchically structured and is implemented on a simple PC-AT computer. The hand's dexterity and intelligence are demonstrated with some experiments. E.R.

N90-29790*# Oak Ridge National Lab., TN.

TRACTION-DRIVE FORCE TRANSMISSION FOR TELEROBOTIC JOINTS **c37**

D. P. Kuban and D. M. Williams *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 103-115 Previously announced as N89-25461 (For primary document see N90-29780 24-54)

(MMES-40-1553-85)

Avail: NTIS HC A23/MF A04 CSCL 05H

The U.S. Space Station Program is providing many technological developments to meet the increasing demands of designing such a facility. One of the key areas of research is that of telerobotics for space station assembly and maintenance. Initial implementation will be teleoperated, but long-term plans call for autonomous robotics. One of the essential components for making this transition successful is the manipulator joints mechanism. Historically, teleoperated manipulators and industrial robotics have had very different mechanisms for force transmission. This is because the design objectives are almost mutually exclusive. A teleoperator must have very low friction and inertia to minimize operator fatigue; backlash and stiffness are of secondary concern. A robot, however, must have minimum backlash, and high stiffness for accurate and rapid positioning. A joint mechanism has yet to be developed that can optimize these divergent performance objectives. A joint mechanism that approaches this optimal performance was developed for NASA Langley, Automation Technology Branch. It is a traction-drive differential that uses variable preload mechanisms. The differential provides compact, dexterous motion range with a torque density similar to geared systems. The traction drive offers high stiffness and zero backlash, for good robotic performance, and the variable loading mechanism (VLM) minimizes the drive-train friction, for improved teleoperation. Author

N90-29791*# Louvain Univ. (Belgium). Dept. of Mechanical Engineering.

FORCE/TORQUE AND TACTILE SENSORS FOR SENSOR-BASED MANIPULATOR CONTROL

H. VanBrussel, H. Beiieen, and Chao-Ying Bao *In* JPL, California

Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 117-128 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

The autonomy of manipulators, in space and in industrial environments, can be dramatically enhanced by the use of force/torque and tactile sensors. The development and future use of a six-component force/torque sensor for the Hermes Robot Arm (HERA) Basic End-Effector (BEE) is discussed. Then a multifunctional gripper system based on tactile sensors is described. The basic transducing element of the sensor is a sheet of pressure-sensitive polymer. Tactile image processing algorithms for slip detection, object position estimation, and object recognition are described. Author

N90-29792*# Politecnico di Milano (Italy). Dept. of Mechanics.
REDUNDANT SENSORIZED ARM+HAND SYSTEM FOR SPACE TELEROBOTIZED MANIPULATION
Alberto Rovetta and Paolo Cavestro *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 129-134 Sponsored in part by the Italian Educational Ministry (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

An integrated system, composed of an arm, a wrist, and a mechanical multifingered hand is treated. The hand is on development for possible application in telemanipulation, and is realized in separate parts. The redundancy of the degrees of freedom of the system, the sensors, the application of logical rules, and the supervision of teleoperators may be applied in order to have an optimum of reliability of the system in space telemanipulations. E.R.

N90-29793*# ST Systems Corp., Lanham, MD.
IMPEDANCE HAND CONTROLLERS FOR INCREASING EFFICIENCY IN TELEOPERATIONS
C. Carignan and J. Tarrant *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 135-144 Previously announced as N89-26393 (For primary document see N90-29780 24-54)
(Contract NAS5-28561)
Avail: NTIS HC A23/MF A04 CSCL 05H

An impedance hand controller with direct force feedback is examined as an alternative to bilateral force reflection in teleoperations involving force contact. Experimentation revealed an operator preference for direct force feedback which provided a better feel of contact with the environment. The advantages of variable arm impedance were also made clear in tracking tests where subjects preferred the larger hand controller inertias made possible by the acceleration feedback loop in the master arm. The ability to decouple the hand controller impedance from the slave arm dynamics is expected to be even more significant when the inertial properties of various payloads in the slave arm are considered. Author

N90-29794*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
TELE-AUTONOMOUS SYSTEMS: NEW METHODS FOR PROJECTING AND COORDINATING INTELLIGENT ACTION AT A DISTANCE
Lynn Conway, Richard Volz (Texas A&M Univ., College Station.), and Michael W. Walker *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 147-157 Sponsored in part by Research Excellence Fund, State of Michigan (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

There is a growing need for humans to perform complex remote operations and to extend the intelligence and experience of experts to distant applications. It is asserted that a blending of human intelligence, modern information technology, remote control, and intelligent autonomous systems is required, and have coined the term tele-autonomous technology, or tele-automation, for methods producing intelligent action at a distance. Tele-automation goes beyond autonomous control by blending in human intelligence. It goes beyond tele-operation by incorporating as much autonomy as possible and/or reasonable. A new approach is discussed for solving one of the fundamental problems facing tele-autonomous systems: The need to overcome time delays due to telemetry and signal propagation. New concepts are introduced called time and position clutches, that allow the time and position frames between the local user control and the remote device being controlled, to be desynchronized respectively. The design and implementation of these mechanisms are described in detail. It is demonstrated that these mechanisms lead to substantial telemanipulation performance improvements, including the result of improvements even in the absence of time delays. The new controls also yield a simple protocol for control handoffs of manipulation tasks between local operators and remote systems. Author

N90-29795*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
AN ADVANCED TELEROBOTIC SYSTEM FOR SHUTTLE PAYLOAD CHANGEOUT ROOM PROCESSING APPLICATIONS
M. Sklar (McDonnell-Douglas Space Systems Co., Cocoa Beach, FL.) and D. Wegerif *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 159-170 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

To potentially alleviate the inherent difficulties in the ground processing of the Space Shuttle and its associated payloads, a teleoperated, semi-autonomous robotic processing system for the Payload Changeout Room (PCR) is now in the conceptual stages. The complete PCR robotic system as currently conceived is described and critical design issues and the required technologies are discussed. E.R.

N90-29796*# Mechanical Engineering Lab., Tsukuba (Japan).
ROBOTIC TELE-EXISTENCE
Susumu Tachi, Hirohiko Arai, and Taro Maeda *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 171-180 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

Tele-existence is an advanced type of teleoperation system that enables a human operator at the controls to perform remote manipulation tasks dexterously with the feeling that he or she exists in the remote anthropomorphic robot in the remote environment. The concept of a tele-existence is presented, the principle of the tele-existence display method is explained, some of the prototype systems are described, and its space application is discussed. Author

N90-29797*# California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
REDUNDANCY OF SPACE MANIPULATOR ON FREE-FLYING VEHICLE AND ITS NONHOLONOMIC PATH PLANNING
Yoshihiko Nakamura and Ranjan Mukherjee *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 181-190 Sponsored in part by NSF (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

The nonholonomic mechanical structure of space robots and path planning is discussed. The angular momentum conservation works as a nonholonomic constraint while the linear momentum conservation is a holonomic one. Thus, a vehicle with a 6 d.o.f. manipulator is described as a 9 variable system with 6 inputs. This implies the possibility of controlling the vehicle orientation and the joint variables of the manipulator by actuating the joint variables, but only if the trajectory is carefully planned; however, both of them cannot be controlled independently. It means that by assuming feasible-path planning, a system that consists of a vehicle and a 6 d.o.f. manipulator can be utilized as 9 d.o.f. system. Initially, the nonholonomic mechanical structure of space

vehicle/manipulator system is shown. Then a path planning scheme for nonholonomic systems is proposed using Lyapunov functions.
Author

N90-29798*# Boeing Aerospace Co., Seattle, WA.
GUIDANCE ALGORITHMS FOR A FREE-FLYING SPACE ROBOT **c61**
A. F. Brindle, H. E. M. Viggh, and J. H. Albert *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 191-200 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

Robotics is a promising technology for assembly, servicing, and maintenance of platforms in space. Several aspects of planning and guidance for telesupervised and fully autonomous robotic servicers are investigated. Guidance algorithms for proximity operation of a free flyer are described. Numeric trajectory optimization is combined with artificial intelligence based obstacle avoidance. An initial algorithm and the results of its simulating platform servicing scenario are discussed. A second algorithm experiment is then proposed.
Author

N90-29799*# Florida Univ., Gainesville. Center for Intelligent Machines and Robotics.
TELEPRESENCE SYSTEM DEVELOPMENT FOR APPLICATION TO THE CONTROL OF REMOTE ROBOTIC SYSTEMS
Carl D. Crane, III, Joseph Duffy, Rajul Vora, and Shih-Chien Chiang *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 201-210 Sponsored in part by DOE, Army, McDonnell Douglas Astronautics Co., and Honeywell (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

The recent developments of techniques which assist an operator in the control of remote robotic systems are described. In particular, applications are aimed at two specific scenarios: The control of remote robot manipulators; and motion planning for remote transporter vehicles. Common to both applications is the use of realistic computer graphics images which provide the operator with pertinent information. The specific system developments for several recently completed and ongoing telepresence research projects are described.
Author

N90-29800*# California Univ., Berkeley. Telerobotics Unit.
THE 3D MODEL CONTROL OF IMAGE PROCESSING
An H. Nguyen and Lawrence Stark *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 213-222 Sponsored by NASA, Ames Research Center (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

Telerobotics studies remote control of distant robots by a human operator using supervisory or direct control. Even if the robot manipulators has vision or other senses, problems arise involving control, communications, and delay. The communication delays that may be expected with telerobots working in space stations while being controlled from an Earth lab have led to a number of experiments attempting to circumvent the problem. This delay in communication is a main motivating factor in moving from well understood instantaneous hands-on manual control to less well understood supervisory control; the ultimate step would be the realization of a fully autonomous robot. The 3-D model control plays a crucial role in resolving many conflicting image processing problems that are inherent in resolving in the bottom-up approach of most current machine vision processes. The 3-D model control approach is also capable of providing the necessary visual feedback information for both the control algorithms and for the human operator.
E.R.

N90-29801*# Purdue Univ., West Lafayette, IN. School of Electrical Engineering.
WEIGHTED FEATURE SELECTION CRITERIA FOR VISUAL SERVOING OF A TELEROBOT
John T. Feddema, C. S. G. Lee, and O. R. Mitchell *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 223-233 Sponsored in part by IBM (For primary document see N90-29780 24-54)
(Grant NSF CDR-88-03017)
Avail: NTIS HC A23/MF A04 CSCL 05H

Because of the continually changing environment of a space station, visual feedback is a vital element of a telerobotic system. A real time visual servoing system would allow a telerobot to track and manipulate randomly moving objects. Methodologies for the automatic selection of image features to be used to visually control the relative position between an eye-in-hand telerobot and a known object are devised. A weighted criteria function with both image recognition and control components is used to select the combination of image features which provides the best control. Simulation and experimental results of a PUMA robot arm visually tracking a randomly moving carburetor gasket with a visual update time of 70 milliseconds are discussed.
Author

N90-29802*# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France).
TRINOCULAR STEREOVISION USING FIGURAL CONTINUITY, DEALING WITH CURVED OBJECTS
R. Vaillant and O. D. Faugeras *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 235-244 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

A method to build a dense and reliable 3-D description of a scene from three digital images by means of passive stereovision is presented. This method uses figural continuity to improve the results of a previously developed algorithm. In particular, it copes much better with curved objects and produces results which are organized as 3-D chains of segments.
Author

N90-29803*# National Research Council of Canada, Ottawa (Ontario).
A FAST 3-D OBJECT RECOGNITION ALGORITHM FOR THE VISION SYSTEM OF A SPECIAL-PURPOSE DEXTEROUS MANIPULATOR **c61**
Stephen H. Y. Hung *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 245-254 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

A fast 3-D object recognition algorithm that can be used as a quick-look subsystem to the vision system for the Special-Purpose Dexterous Manipulator (SPDM) is described. Global features that can be easily computed from range data are used to characterize the images of a viewer-centered model of an object. This algorithm will speed up the processing by eliminating the low level processing whenever possible. It may identify the object, reject a set of bad data in the early stage, or create a better environment for a more powerful algorithm to carry the work further.
Author

N90-29804*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
USE OF 3D VISION FOR FINE ROBOT MOTION
Anatole Lokshin and Todd Litwin *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 255-262 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

An integration of 3-D vision systems with robot manipulators will allow robots to operate in a poorly structured environment by visually locating targets and obstacles. However, by using computer vision for objects acquisition makes the problem of overall system calibration even more difficult. Indeed, in a CAD based manipulation a control architecture has to find an accurate mapping between the 3-D Euclidean work space and a robot configuration space (joint angles). If a stereo vision is involved, then one needs to map a pair of 2-D video images directly into the robot configuration

space. Neural Network approach aside, a common solution to this problem is to calibrate vision and manipulator independently, and then tie them via common mapping into the task space. In other words, both vision and robot refer to some common Absolute Euclidean Coordinate Frame via their individual mappings. This approach has two major difficulties. First a vision system has to be calibrated over the total work space. And second, the absolute frame, which is usually quite arbitrary, has to be the same with a high degree of precision for both robot and vision subsystem calibrations. The use of computer vision to allow robust fine motion manipulation in a poorly structured world which is currently in progress is described along with the preliminary results and encountered problems. Author

N90-29805*# Bolt, Beranek, and Newman, Inc., Cambridge, MA.

TELEROBOTIC WORKSTATION DESIGN AID

K. Corker, E. Hudlicka, D. Young, and N. Cramer *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 265-275 Sponsored in part by JPL and NASA, Ames Research Center (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

Telerobot systems are being developed to support a number of space mission applications. In low earth orbit, telerobots and teleoperated manipulators will be used in shuttle operations and space station construction/maintenance. Free flying telerobotic service vehicles will be used at low and geosynchronous orbital operations. Rovers and autonomous vehicles will be equipped with telerobotic devices in planetary exploration. In all of these systems, human operators will interact with the robot system at varied levels during the scheduled operations. The human operators may be in either orbital or ground-based control systems. To assure integrated system development and maximum utility across these systems, designers must be sensitive to the constraints and capabilities that the human brings to system operation and must be assisted in applying these human factors to system development. The simulation and analysis system is intended to serve the needs of system analysis/designers as an integrated workstation in support of telerobotic design. Author

N90-29806*# Tecnospazio S.p.A., Milan (Italy).

SPACE ROBOTIC SYSTEM FOR PROXIMITY OPERATIONS

P. G. Magnani and M. Colomba *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 277-285 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

Key to an efficient accomplishment of space station servicing operations is the development of a scenario where the presence of man in space is well integrated with the capability of teleoperated and automatic robot system outside the stations. Results focusing on mission requirements, trajectory sequences, propulsion subsystem features, and manipulative kit characteristics relevant to proximity servicing during a Man Tended Free Flyers Robotic Mission (MTFF-RM) are illustrated. E.R.

N90-29807*# Osaka Univ., Toyonaka (Japan). Dept. of Mechanical Engineering.

MODELING AND SENSORY FEEDBACK CONTROL FOR SPACE MANIPULATORS

Yasuhiro Masutani, Fumio Miyazaki, and Suguru Arimoto *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 287-296 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

The positioning control problem of the endtip of space manipulators whose base are uncontrolled is examined. In such a case, the conventional control method for industrial robots based on a local feedback at each joint is not applicable, because a solution of the joint displacements that satisfies a given position and orientation of the endtip is not decided uniquely. A sensory feedback control scheme for space manipulators based on an artificial potential defined in a task-oriented coordinates is proposed. Using this scheme, the controller can easily determine the input torque of each joint from the data of an external sensor such as a visual device. Since the external sensor is mounted on the unfixed base, the manipulator must track the moving image of the target in sensor coordinates. Moreover the dynamics of the base and the manipulator are interactive. However, the endtip is proven to asymptotically approach the stationary target in an inertial coordinate frame by the Liapunov's method. Finally results of computer simulation for a 6-link space manipulator model show the effectiveness of the proposed scheme. Author

N90-29808*# Grumman Aerospace Corp., Bethpage, NY. Advanced Systems.

CONTROL STRATEGIES FOR A TELEROBOT **c63**

John OHara and Bill Stasi *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 297-306 (For primary document see N90-29780 24-54)

(Contract NAS9-17229)

Avail: NTIS HC A23/MF A04 CSCL 05H

One of the major issues impacting the utility of telerobotic systems for space is the development of effective control strategies. For near-term applications, telerobot control is likely to utilize teleoperation methodologies with integrated supervisory control capabilities to assist the operator. Two different approaches to telerobotic control are evaluated: bilateral force reflecting master controllers and proportional rate six degrees-of-freedom hand controllers. The controllers' performance of single manipulator arm tasks is compared. Simultaneous operation of both manipulator arms and complex multiaxis slave arm movements is investigated. Task times are significantly longer and fewer errors are committed with the hand controllers. The hand controllers are also rated significantly higher in cognitive and manual control workload on the two-arm task. The master controllers are rated significantly higher in physical workload. The implications of these findings for space teleoperations and higher levels of control are discussed. Author

N90-29809*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AUTONOMOUS SENSOR-BASED DUAL-ARM SATELLITE GRAPPLING

Brian Wilcox, Kam Tso, Todd Litwin, Samad Hayati, and Bruce Bon *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 307-316 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

Dual-arm satellite grappling involves the integration of technologies developed in the Sensing and Perception (S&P) Subsystem for object acquisition and tracking, and the Manipulator Control and Mechanization (MCM) Subsystem for dual-arm control. S&P acquires and tracks the position, orientation, velocity, and angular velocity of a slowly spinning satellite, and sends tracking data to the MCM subsystem. MCM grapples the satellite and brings it to rest, controlling the arms so that no excessive forces or torques are exerted on the satellite or arms. A 350-pound satellite mockup which can spin freely on a gimbal for several minutes, closely simulating the dynamics of a real satellite is demonstrated. The satellite mockup is fitted with a panel under which may be mounted various elements such as line replacement modules and electrical connectors that will be used to demonstrate servicing tasks once the satellite is docked. The subsystems are housed in three MicroVAX II microcomputers. The hardware of the S&P Subsystem includes CCD cameras, video digitizers, frame buffers, IMFEX (a custom pipelined video processor), a time-code generator with millisecond precision, and a MicroVAX II computer. Its software is written in Pascal and is based on a locally written vision software library. The hardware of the MCM Subsystem includes PUMA 560 robot arms, Lord force/torque sensors, two MicroVAX II computers, and unimation pneumatic parallel grippers. Its software is written in C, and is based on a robot language called RCCL. The two

subsystems are described and test results on the grappling of the satellite mockup with rotational rates of up to 2 rpm are provided. Author

N90-29810*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THREAD: A PROGRAMMING ENVIRONMENT FOR INTERACTIVE PLANNING-LEVEL ROBOTICS APPLICATIONS
c61
John J. Beahan, Jr. *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 317-327 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

THREAD programming language, which was developed to meet the needs of researchers in developing robotics applications that perform such tasks as grasp, trajectory design, sensor data analysis, and interfacing with external subsystems in order to perform servo-level control of manipulators and real time sensing is discussed. The philosophy behind THREAD, the issues which entered into its design, and the features of the language are discussed from the viewpoint of researchers who want to develop algorithms in a simulation environment, and from those who want to implement physical robotics systems. The detailed functions of the many complex robotics algorithms and tools which are part of the language are not explained, but an overall impression of their capability is given. E.R.

N90-29811*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
STABILITY ANALYSIS OF MULTIPLE-ROBOT CONTROL SYSTEMS
John T. Wen (Rensselaer Polytechnic Inst., Troy, NY.) and Kenneth Kreutz *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 331-340 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

In a space telerobotic service scenario, cooperative motion and force control of multiple robot arms are of fundamental importance. Three paradigms to study this problem are proposed. They are distinguished by the set of variables used for control design. They are joint torques, arm tip force vectors, and an accelerated generalized coordinate set. Control issues related to each case are discussed. The latter two choices require complete model information, which presents practical modeling, computational, and robustness problems. Therefore, focus is on the joint torque control case to develop relatively model independent motion and internal force control laws. The rigid body assumption allows the motion and force control problems to be independently addressed. By using an energy motivated Lyapunov function, a simple proportional derivative plus gravity compensation type of motion control law is always shown to be stabilizing. The asymptotic convergence of the tracing error to zero requires the use of a generalized coordinate with the contact constraints taken into account. If a non-generalized coordinate is used, only convergence to a steady state manifold can be concluded. For the force control, both feedforward and feedback schemes are analyzed. The feedback control, if proper care has been taken, exhibits better robustness and transient performance. Author

N90-29812*# Stanford Univ., CA. Aerospace Robotics Lab.
EXPERIMENTS IN COOPERATIVE MANIPULATION: A SYSTEM PERSPECTIVE
Stanley A. Schneider and Robert H. Cannon, Jr. *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 341-350 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

In addition to cooperative dynamic control, the system incorporates real time vision feedback, a novel programming technique, and a graphical high level user interface. By focusing on the vertical integration problem, not only these subsystems are examined, but also their interfaces and interactions. The control system implements a multi-level hierarchical structure; the techniques developed for operator input, strategic command, and cooperative dynamic control are presented. At the highest level, a mouse-based graphical user interface allows an operator to direct the activities of the system. Strategic command is provided by a table-driven finite state machine; this methodology provides a powerful yet flexible technique for managing the concurrent system interactions. The dynamic controller implements object impedance control; an extension of Nevill Hogan's impedance control concept to cooperative arm manipulation of a single object. Experimental results are presented, showing the system locating and identifying a moving object catching it, and performing a simple cooperative assembly. Results from dynamic control experiments are also presented, showing the controller's excellent dynamic trajectory tracking performance, while also permitting control of environmental contact force. Author

N90-29813*# Naples Univ. (Italy). Dipt. di Informatica e Sistemistica.
ON THE MANIPULABILITY OF DUAL COOPERATIVE ROBOTS
P. Chiacchio, S. Chiaverini, L. Sciavicco, and B. Siciliano *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 351-360 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

The definition of manipulability ellipsoids for dual robot systems is given. A suitable kineto-static formulation for dual cooperative robots is adopted which allows for a global task space description of external and internal forces, and relative velocities. The well known concepts of force and velocity manipulability ellipsoids for a single robot are formally extended and the contributions of the two single robots to the cooperative system ellipsoids are illustrated. Duality properties are discussed. A practical case study is developed. Author

N90-29814*# California Univ., Santa Barbara. Center for Robotic Systems in Microelectronics.
CONTROLLING MULTIPLE MANIPULATORS USING RIPS
Yulun Wang, Steve Jordan, Amante Mangaser, and Steve Butner *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 361-370 Sponsored in part by NSF and by Rockwell International (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

A prototype of the RIPS architecture (Robotic Instruction Processing System) was developed. A two arm robot control experiment is underway to characterize the architecture as well as research multi-arm control. This experiment uses two manipulators to cooperatively position an object. The location of the object is specified by the host computer's mouse. Consequently, real time kinematics and dynamics are necessary. The RIPS architecture is specialized so that it can satisfy these real time constraints. The two arm experimental set-up is discussed. A major part of this work is the continued development of a good programming environment for RIPS. The C++ language is employed and favorable results exist in the targeting of this language to the RIPS hardware. Author

N90-29815*# California Univ., Irvine. Dept. of Mechanical Engineering.
TIME OPTIMAL MOVEMENT OF COOPERATING ROBOTS
J. M. McCarthy and J. E. Bobrow *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 371-379 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

The maximization of the speed of movement along a prescribed path, of the system formed by a set of robot arms and the object they hold is examined. The actuator torques that maximize the acceleration of the system are shown to be determined by the solution to a standard linear programming problem. The combination of this result with the known control strategy for time optimal movement of a single robot arm yields an algorithm for

time optimal movement of multiple robot arms holding the same workpiece. Author

N90-29816*# Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Inst.

REFLECTIONS ON THE RELATIONSHIP BETWEEN ARTIFICIAL INTELLIGENCE AND OPERATIONS RESEARCH **c63**

Mark S. Fox *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 383-394 Sponsored in part by Digital Equipment Corp. (For primary document see N90-29780 24-54)

(Contract F30602-88-C-0001)

Avail: NTIS HC A23/MF A04 CSCL 05H

Historically, part of Artificial Intelligence's (AI's) roots lie in Operations Research (OR). How AI has extended the problem solving paradigm developed in OR is explored. In particular, by examining how scheduling problems are solved using OR and AI, it is demonstrated that AI extends OR's model of problem solving through the opportunistic use of knowledge, problem reformulation and learning. Author

N90-29817*# Ohio State Univ., Columbus. Lab. for AI Research.

WHAT KIND OF COMPUTATION IS INTELLIGENCE. A FRAMEWORK FOR INTEGRATING DIFFERENT KINDS OF EXPERTISE **c63**

B. Chandrasekaran *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 395-402 (For primary document see N90-29780 24-54)

(Contract F30602-85-C-0010; AF-AFOSR-0090-87)

Avail: NTIS HC A23/MF A04 CSCL 05H

The view that the deliberative aspect of intelligent behavior is a distinct type of algorithm; in particular, a goal-seeking exploratory process using qualitative representations of knowledge and inference is elaborated. There are other kinds of algorithms that also embody expertise in domains. The different types of expertise and how they can and should be integrated to give full account of expert behavior are discussed. Author

N90-29818*# Edinburgh Univ. (Scotland). Dept. of Artificial Intelligence.

A DESIGN STRATEGY FOR AUTONOMOUS SYSTEMS **c63**

Pete Forster *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 403-414 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

Some solutions to crucial issues regarding the competent performance of an autonomously operating robot are identified; namely, that of handling multiple and variable data sources containing overlapping information and maintaining coherent operation while responding adequately to changes in the environment. Support for the ideas developed for the construction of such behavior are extracted from speculations in the study of cognitive psychology, an understanding of the behavior of controlled mechanisms, and the development of behavior-based robots in a few robot research laboratories. The validity of these ideas is supported by some simple simulation experiments in the field of mobile robot navigation and guidance. Author

N90-29819*# Michigan Univ., Ann Arbor. Artificial Intelligence Lab.

LEARNING IN TELE-AUTONOMOUS SYSTEMS USING SOAR **c63**

John E. Laird, Eric S. Yager, Christopher M. Tuck, and Michael Hucka *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 415-424 (For primary document see N90-29780 24-54)

(Contracts NCC2-517; N00014-88-K-0554)

Avail: NTIS HC A23/MF A04 CSCL 05H

Robo-Soar is a high-level robot arm control system implemented in Soar. Robo-Soar learns to perform simple block manipulation tasks using advice from a human. Following learning, the system is able to perform similar tasks without external guidance. It can also learn to correct its knowledge, using its own problem solving in addition to outside guidance. Robo-Soar corrects its knowledge by accepting advice about relevance of features in its domain, using a unique integration of analytic and empirical learning techniques. Author

N90-29820*# Missouri Univ., Rolla. Dept. of Electrical Engineering.

DESIGN OF A STRUCTURAL AND FUNCTIONAL HIERARCHY FOR PLANNING AND CONTROL OF TELEROBOTIC SYSTEMS **c63**

Levent Acar and Umit Ozguner (Ohio State Univ., Columbus.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 425-434 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

Hierarchical structures offer numerous advantages over conventional structures for the control of telerobotic systems. A hierarchically organized system can be controlled via undetailed task assignments and can easily adapt to changing circumstances. The distributed and modular structure of these systems also enables fast response needed in most telerobotic applications. On the other hand, most of the hierarchical structures proposed in the literature are based on functional properties of a system. These structures work best for a few given functions of a large class of systems. In telerobotic applications, all functions of a single system needed to be explored. This approach requires a hierarchical organization based on physical properties of a system and such a hierarchical organization is introduced. The decomposition, organization, and control of the hierarchical structure are considered, and a system with two robot arms and a camera is presented. Author

N90-29821*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE FLIGHT TELEROBOTIC SERVICER PROJECT: A TECHNICAL OVERVIEW

Harry G. McCain *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 437-445 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

The Flight Telerobotic Servicer (FTS) technical challenge is the development and integration of a spaceflight quality system with both teleoperative and autonomous capabilities. The system must be safe and reliable in the space environment. Background and rationale leading to the desired FTS telerobotic capabilities are provided. Some of the specific technical requirements to which the FTS must be designed in order to meet the projects goals and operate effectively in the space environment are described. E.R.

N90-29822*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE FLIGHT TELEROBOTIC SERVICER TINMAN CONCEPT: SYSTEM DESIGN DRIVERS AND TASK ANALYSIS

J. F. Andary, D. R. Hewitt, and S. W. Hinkal *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 447-471 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

A study was conducted to develop a preliminary definition of the Flight Telerobotic Servicer (FTS) that could be used to understand the operational concepts and scenarios for the FTS. Called the Tinman, this design concept was also used to begin the process of establishing resources and interfaces for the FTS on Space Station Freedom, the National Space Transportation System shuttle orbiter, and the Orbital Maneuvering vehicle. Starting with an analysis of the requirements and task capabilities as stated

in the Phase B study requirements document, the study identified eight major design drivers for the FTS. Each of these design drivers and their impacts on the Tinman design concept are described. Next, the planning that is currently underway for providing resources for the FTS on Space Station Freedom is discussed, including up to 2000 W of peak power, up to four color video channels, and command and data rates up to 500 kbps between the telerobot and the control station. Finally, an example is presented to show how the Tinman design concept was used to analyze task scenarios and explore the operational capabilities of the FTS. A structured methodology using a standard terminology consistent with the NASA/National Bureau of Standards Standard Reference Model for Telerobot Control System Architecture (NASREM) was developed for this analysis. Author

N90-29823*# National Inst. of Standards and Technology, Gaithersburg, MD. Robot Systems Div.

THE FLIGHT TELEROBOTIC SERVICER: FROM FUNCTIONAL ARCHITECTURE TO COMPUTER ARCHITECTURE

Ronald Lumia and John Fiala *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 473-482 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

After a brief tutorial on the NASA/National Bureau of Standards Standard Reference Model for Telerobot Control System Architecture (NASREM) functional architecture, the approach to its implementation is shown. First, interfaces must be defined which are capable of supporting the known algorithms. This is illustrated by considering the interfaces required for the SERVO level of the NASREM functional architecture. After interface definition, the specific computer architecture for the implementation must be determined. This choice is obviously technology dependent. An example illustrating one possible mapping of the NASREM functional architecture to a particular set of computers which implements it is shown. The result of choosing the NASREM functional architecture is that it provides a technology independent paradigm which can be mapped into a technology dependent implementation capable of evolving with technology in the laboratory and in space. E.R.

N90-29824*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

RESEARCH AND DEVELOPMENT ACTIVITIES AT THE GODDARD SPACE FLIGHT CENTER FOR THE FLIGHT TELEROBOTIC SERVICER PROJECT

Stanford Ollendorf *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 483-489 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

The Flight Telerobotic Servicer (FTS) is being developed by the Goddard Space Flight Center (GSFC) for performing a variety of assembly, servicing, inspection and maintenance tasks on the Space Station. The Project Office at GSFC has tasked the Engineering Directorate to assemble a robotics research and development program which will support the FTS project. The activities center around support for the Development Test Flight (DTF) on the Space Shuttle and investigations of operational problems associated with the FTS on Space Station Freedom. For the DTF, areas such as control algorithms, safety systems, and end-effectors will be developed. For FTS operations, the emphasis will be to develop a dual-arm bi-lateral force-reflecting teleoperator and use it as an FTS Operational Simulator (FTSOS). The simulator will be used to investigate operational techniques, camera configurations, operator interfacing, orbital replacement unit (ORU) designs, end-effector designs, and training techniques. After a series of test activities, reports will be generated for input to the DTF and FTS designs. Author

N90-29825*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THE GODDARD SPACE FLIGHT CENTER (GSFC) ROBOTICS TECHNOLOGY TESTBED

Rick Schnurr, Maureen OBrien, and Sue Cofer (Digital Equipment Corp., Landover, MD.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 491-500 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

Much of the technology planned for use in NASA's Flight Telerobotic Servicer (FTS) and the Demonstration Test Flight (DTF) is relatively new and untested. To provide the answers needed to design safe, reliable, and fully functional robotics for flight, NASA/GSFC is developing a robotics technology testbed for research of issues such as zero-g robot control, dual arm teleoperation, simulations, and hierarchical control using a high level programming language. The testbed will be used to investigate these high risk technologies required for the FTS and DTF projects. The robotics technology testbed is centered around the dual arm teleoperation of a pair of 7 degree-of-freedom (DOF) manipulators, each with their own 6-DOF mini-master hand controllers. Several levels of safety are implemented using the control processor, a separate watchdog computer, and other low level features. High speed input/output ports allow the control processor to interface to a simulation workstation: all or part of the testbed hardware can be used in real time dynamic simulation of the testbed operations, allowing a quick and safe means for testing new control strategies. The NASA/National Bureau of Standards Standard Reference Model for Telerobot Control System Architecture (NASREM) hierarchical control scheme, is being used as the reference standard for system design. All software developed for the testbed, excluding some of simulation workstation software, is being developed in Ada. The testbed is being developed in phases. The first phase, which is nearing completion, and highlights future developments is described. Author

N90-29826*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

TEST AND VALIDATION FOR ROBOT ARM CONTROL DYNAMICS SIMULATION

K. Harold Yae, Sung-Soo Kim, Edward J. Haug, Warren Seering, Kamala Sundaram, Bruce Thompson, James Turner, Hon Chun (Cambridge Research Associates, MA.), Harold P. Frisch, and Richard Schnurr *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 501-507 (For primary document see N90-29780 24-54)

Avail: NTIS HC A23/MF A04 CSCL 05H

The Flight Telerobotic Servicer (FTS) program will require an ability to develop, in a cost effective manner, many simulation models for design, analysis, performance evaluation, and crew training. Computational speed and the degree of modeling fidelity associated with each simulation must be commensurate with problem objectives. To demonstrate evolving state-of-the-art general purpose multibody modeling capabilities, to validate these by laboratory testing, and to expose their modeling shortcomings, two focus problems at the opposite ends of the simulation spectrum are defined: (1) Coarse Acquisition Control Dynamics. Create a real time man-in-the-control-loop simulator. Provide animated graphical display of robot arm dynamics and tactile feedback sufficient for cueing the operator. Interface simulator software with human operated tactile feedback controller; i.e., the Kraft mini-master. (2) Fine, Precision Mode Control Dynamics. Create a high speed, high fidelity simulation model for the design, analysis, and performance evaluation of autonomous 7 degree-of-freedom (DOF) trajectory control algorithms. This model must contain detail dynamic models for all significant dynamics elements within the robot arm, such as joint drive mechanisms. Author

N90-29827*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GRAPHIC OVERLAYS IN HIGH-PRECISION TELEOPERATION: CURRENT AND FUTURE WORK AT JPL c61
Daniel B. Diner and Steven C. Venema *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 511-520 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

In space teleoperation additional problems arise, including signal transmission time delays. These can greatly reduce operator performance. Recent advances in graphics open new possibilities for addressing these and other problems. Currently a multi-camera system with normal 3-D TV and video graphics capabilities is being developed. Trained and untrained operators will be tested for high precision performance using two force reflecting hand controllers and a voice recognition system to control two robot arms and up to 5 movable stereo or non-stereo TV cameras. A number of new techniques of integrating TV and video graphics displays to improve operator training and performance in teleoperation and supervised automation are evaluated. Author

N90-29828*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HEAD-MOUNTED SPATIAL INSTRUMENTS II: SYNTHETIC REALITY OR IMPOSSIBLE DREAM
Stephen R. Ellis and Arthur Grunwald (Technion - Israel Inst. of Tech., Haifa.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 521-532 Presented at the AGARD Meeting of the Aerospace Medicine Panel, Brussels, Belgium, 28 Sep. - 2 Oct. 1987; and at the California Mapping Conference, San Jose, CA, 1988 Previously announced as N89-12184 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

A spatial instrument is defined as a spatial display which has been either geometrically or symbolically enhanced to enable a user to accomplish a particular task. Research conducted over the past several years on 3-D spatial instruments has shown that perspective displays, even when viewed from the correct viewpoint, are subject to systematic viewer biases. These biases interfere with correct spatial judgements of the presented pictorial information. The design of spatial instruments may not only require the introduction of compensatory distortions to remove the naturally occurring biases but also may significantly benefit from the introduction of artificial distortions which enhance performance. However, these image manipulations can cause a loss of visual-vestibular coordination and induce motion sickness. Consequently, the design of head-mounted spatial instruments will require an understanding of the tolerable limits of visual-vestibular discord. Author

N90-29829*# Massachusetts Inst. of Tech., Cambridge. Man-Machine Systems Lab.
USE OF GRAPHICS IN DECISION AIDS FOR TELEROBOTIC CONTROL: (PARTS 5-8 OF AN 8-PART MIT PROGRESS REPORT) c63
Thomas B. Sheridan, James B. Roseborough, Hari Das, Kan-Ping Chin, and Seiichi Inoue *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 533-541 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

Four separate projects recently completed or in progress at the MIT Man-Machine Systems Laboratory are summarized. They are: a decision aid for retrieving a tumbling satellite in space; kinematic control and graphic display of redundant teleoperators; real time terrain/object generation: a quad-tree approach; and two dimensional control for three dimensional obstacle avoidance. Author

N90-29830*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE NASA CONFERENCE ON SPACE TELEROBOTICS, VOLUME 4
Guillermo Rodriguez, ed. and Homayoun Seraji, ed. 31 Jan. 1989 449 p Conference held in Pasadena, CA, 31 Jan. - 2 Feb. 1989
(Contract NAS7-918)
(NASA-CR-186859; JPL-Publ-87-7-Vol-4; NAS 1.26:186859)
Avail: NTIS HC A19/MF A03 CSCL 05H

Papers presented at the NASA Conference on Space Telerobotics are compiled. The theme of the conference was man-machine collaboration in space. The conference provided a forum for researchers and engineers to exchange ideas on the research and development required for the application of telerobotic technology to the space systems planned for the 1990's and beyond. Volume 4 contains papers related to the following subject areas: manipulator control; telemanipulation; flight experiments (systems and simulators); sensor-based planning; robot kinematics, dynamics, and control; robot task planning and assembly; and research activities at the NASA Langley Research Center. For individual titles, see N90-29831 through N90-29873.

N90-29831*# University of Southern Illinois, Carbondale. Dept. of Electrical Engineering.
AN IMPROVED ADAPTIVE CONTROL FOR REPETITIVE MOTION OF ROBOTS
F. Pourboghrat *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 3-10 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

An adaptive control algorithm is proposed for a class of nonlinear systems, such as robotic manipulators, which is capable of improving its performance in repetitive motions. When the task is repeated, the error between the desired trajectory and that of the system is guaranteed to decrease. The design is based on the combination of a direct adaptive control and a learning process. This method does not require any knowledge of the dynamic parameters of the system. Author

N90-29832*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DIRECT ADAPTIVE CONTROL OF A PUMA 560 INDUSTRIAL ROBOT c63
Homayoun Seraji, Thomas Lee, and Michel Delpech (Centre National d'Etudes Spatiales, Toulouse, France) *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 11-22 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

The implementation and experimental validation of a new direct adaptive control scheme on a PUMA 560 industrial robot is described. The testbed facility consists of a Unimation PUMA 560 six-jointed robot and controller, and a DEC MicroVAX II computer which hosts the Robot Control C Library software. The control algorithm is implemented on the MicroVAX which acts as a digital controller for the PUMA robot, and the Unimation controller is effectively bypassed and used merely as an I/O device to interface the MicroVAX to the joint motors. The control algorithm for each robot joint consists of an auxiliary signal generated by a constant-gain Proportional plus Integral plus Derivative (PID) controller, and an adaptive position-velocity (PD) feedback controller with adjustable gains. The adaptive independent joint controllers compensate for the inter-joint couplings and achieve accurate trajectory tracking without the need for the complex dynamic model and parameter values of the robot. Extensive experimental results on PUMA joint control are presented to confirm the feasibility of the proposed scheme, in spite of strong interactions between joint motions. Experimental results validate the capabilities of the proposed control scheme. The control scheme is extremely simple and computationally very fast for concurrent processing with high sampling rates. Author

N90-29833*# Westinghouse Electric Corp., Madison, PA. Advanced Energy Systems Div.
MODEL BASED MANIPULATOR CONTROL
Lyman J. Petrosky and Irving J. Oppenheim (Carnegie-Mellon Univ., Pittsburgh, PA.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 23-32 (For primary document see N90-29830 24-54)
(Contract DE-AC02-85NE-37947)
Avail: NTIS HC A19/MF A03 CSCL 05H

The feasibility of using model based control (MBC) for robotic manipulators was investigated. A double inverted pendulum system was constructed as the experimental system for a general study of dynamically stable manipulation. The original interest in dynamically stable systems was driven by the objective of high vertical reach (balancing), and the planning of inertially favorable trajectories for force and payload demands. The model-based control approach is described and the results of experimental tests are summarized. Results directly demonstrate that MBC can provide stable control at all speeds of operation and support operations requiring dynamic stability such as balancing. The application of MBC to systems with flexible links is also discussed. M.G.

N90-29834*# California Univ., San Diego, La Jolla. Space Inst.
DISCRETE-TIME ADAPTIVE CONTROL OF ROBOT MANIPULATORS
M. Tarokh *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 33-42 Previously announced in IAA as A90-29974 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

A discrete-time model reference adaptive control scheme is developed for trajectory tracking of robot manipulators. Hyperstability theory is utilized to derive the adaptation laws for the controller gain matrices. It is shown that asymptotic trajectory tracking is achieved despite gross robot parameter variation and uncertainties. The method offers considerable design flexibility and enables the designer to improve the performance of the control system by adjusting free design parameters. The discrete-time adaptation algorithm is extremely simple and is therefore suitable for real-time implementation. Author

N90-29835*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
A DISCRETE DECENTRALIZED VARIABLE STRUCTURE ROBOTIC CONTROLLER
Zuheir S. Tumeh *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 43-52 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

A decentralized trajectory controller for robotic manipulators is designed and tested using a multiprocessor architecture and a PUMA 560 robot arm. The controller is made up of a nominal model-based component and a correction component based on a variable structure suction control approach. The second control component is designed using bounds on the difference between the used and actual values of the model parameters. Since the continuous manipulator system is digitally controlled along a trajectory, a discretized equivalent model of the manipulator is used to derive the controller. The motivation for decentralized control is that the derived algorithms can be executed in parallel using a distributed, relatively inexpensive, architecture where each joint is assigned a microprocessor. Nonlinear interaction and coupling between joints is treated as a disturbance torque that is estimated and compensated for. Author

N90-29836*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONSTRUCTION AND DEMONSTRATION OF A 9-STRING 6 DOF FORCE REFLECTING JOYSTICK FOR TELEROBOTICS
Randel Lindemann and Delbert Tesar (Texas Univ., Austin.) *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 55-63 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Confrontation with difficult manipulation tasks in hostile environments such as space, has led to the development of means to transport the human's senses, skills and cognition to the remote site. The use of advanced Telerobotics to achieve this goal is examined. A novel and universal hand controller based on a fully parallel mechanical architecture is discussed. The design and implementation of this 6 DOF force reflecting joystick is shown in relationship to the general philosophy of achieving telepresence in a man-machine system. Author

N90-29837*# Franklin and Marshall Coll., Lancaster, PA.
RESPONSE TO REFLECTED-FORCE FEEDBACK TO FINGERS IN TELEOPERATIONS
P. H. Sutter, J. C. Iatridis, and N. V. Thakor (Johns Hopkins Univ., Baltimore, MD.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 65-74 Sponsored in part by Johns Hopkins Univ., Baltimore, MD (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Reflected-force feedback is an important aspect of teleoperations. The objective is to determine the ability of the human operator to respond to that force. Telerobotics operation is simulated by computer control of a motor-driven device with capabilities for programmable force feedback and force measurement. A computer-controlled motor drive is developed that provides forces against the fingers as well as (anguiar) position control. A load cell moves in a circular arc as it is pushed by a finger and measures reaction forces on the finger. The force exerted by the finger on the load cell and the angular position are digitized and recorded as a function of time by the computer. Flexure forces of the index, long and ring fingers of the human hand in opposition to the motor driven load cell are investigated. Results of the following experiments are presented: (1) Exertion of maximum finger force as a function of angle; (2) Exertion of target finger force against a computer controlled force; and (3) Test of the ability to move to a target force against a force that is a function of position. Averaged over ten individuals, the maximum force that could be exerted by the index or long finger is about 50 Newtons, while that of the ring finger is about 40 Newtons. From the tests of the ability of a subject to exert a target force, it was concluded that reflected-force feedback can be achieved with the direct kinesthetic perception of force without the use of tactile or visual clues.
Author

N90-29838*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JAU-JPL ANTHROPOMORPHIC TELEROBOT
Bruno M. Jau *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 75-80 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Work in progress on the new anthropomorphic telerobot is described. The initial robot configuration consists of a seven DOF arm and a sixteen DOF hand, having three fingers and a thumb. The robot has active compliance, enabling subsequent dual arm manipulations. To control the rather complex configuration of this robot, an exoskeleton master arm harness and a glove controller were built. The controller will be used for teleoperational tasks and as a research tool to efficiently teach the computer controller advanced manipulation techniques. Author

N90-29839*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A PROCEDURE CONCEPT FOR LOCAL REFLEX CONTROL OF GRASPING
Paolo Fiorini and Jeffrey Chang *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 81-90 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

An architecture is proposed for the control of robotic devices,

and in particular of anthropomorphic hands, characterized by a hierarchical structure in which every level of the architecture contains data and control function with varying degree of abstraction. Bottom levels of the hierarchy interface directly with sensors and actuators, and process raw data and motor commands. Higher levels perform more symbolic types of tasks, such as application of boolean rules and general planning operations. Layers implementation has to be consistent with the type of operation and its requirements for real time control. It is proposed to implement the rule level with a Boolean Artificial Neural Network characterized by a response time sufficient for producing reflex corrective action at the actuator level. Author

N90-29840*# Martin Marietta Aerospace, Denver, CO. Astronautics Group.

PERFORMANCE LIMITATIONS OF BILATERAL FORCE REFLECTION IMPOSED BY OPERATOR DYNAMIC CHARACTERISTICS

Jim D. Chapel *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 91-100 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

A linearized, single-axis model is presented for bilateral force reflection which facilitates investigation into the effects of manipulator, operator, and task dynamics, as well as time delay and gain scaling. Structural similarities are noted between this model and impedance control. Stability results based upon this model impose requirements upon operator dynamic characteristics as functions of system time delay and environmental stiffness. An experimental characterization reveals the limited capabilities of the human operator to meet these requirements. A procedure is presented for determining the force reflection gain scaling required to provide stability and acceptable operator workload. This procedure is applied to a system with dynamics typical of a space manipulator, and the required gain scaling is presented as a function of environmental stiffness. Author

N90-29841*# Pisa Univ. (Italy). Dipt. di Ingegneria Aerospaziale.

SENSOR-BASED FINE TELEMANIPULATION FOR SPACE ROBOTICS

M. Andrenucci, M. Bergamasco (Scuola Normale Superiore, Pisa, Italy), and P. Dario *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 101-107 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

The control of a multifingered hand slave in order to accurately exert arbitrary forces and impart small movements to a grasped object is, at present, a knotty problem in teleoperation. Although a number of articulated robotic hands have been proposed in the recent past for dexterous manipulation in autonomous robots, the possible use of such hands as slaves in teleoperated manipulation is hindered by the present lack of sensors in those hands, and (even if those sensors were available) by the inherent difficulty of transmitting to the master operator the complex sensations elicited by such sensors at the slave level. An analysis of different problems related to sensor-based telemanipulation is presented. The general sensory systems requirements for dexterous slave manipulators are pointed out and the description of a practical sensory system set-up for the developed robotic system is presented. The problem of feeding back to the human master operator stimuli that can be interpreted by his central nervous system as originated during real dexterous manipulation is then considered. Finally, some preliminary work aimed at developing an instrumented glove designed purposely for commanding the master operation and incorporating Kevlar tendons and tension sensors, is discussed. Author

N90-29842*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ROTEX-TRIIFEX: PROPOSAL FOR A JOINT FRG-USA TELEROBOTIC FLIGHT EXPERIMENT

G. Hirzinger (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) and A. K. Bejczy *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 111-123 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

The concepts and main elements of a RObot Technology EXperiment (ROTEX) proposed to fly with the next German spacelab mission, D2, are presented. It provides a 1 meter size, six axis robot inside a spacelab rack, equipped with a multisensory gripper (force-torque sensors, an array of range finders, and mini stereo cameras). The robot will perform assembly and servicing tasks in a generic way, and will grasp a floating object. The man machine and supervisory control concepts for teleoperation from the spacelab and from ground are discussed. The predictive estimation schemes for an extensive use of time-delay compensating 3D computer graphics are explained. Author

N90-29843*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).

TEST AND TRAINING SIMULATOR FOR GROUND-BASED TELEOPERATED IN-ORBIT SERVICING

Bernd E. Schaefer *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 125-134 (For primary document see N90-29830 24-54)

(Contract DFVLR-5-575-4359)

Avail: NTIS HC A19/MF A03 CSCL 05H

For the Post-IOC(In-Orbit Construction)-Phase of COLUMBUS it is intended to use robotic devices for the routine operations of ground-based teleoperated In-Orbit Servicing. A hardware simulator for verification of the relevant in-orbit operations technologies, the Servicing Test Facility, is necessary which mainly will support the Flight Control Center for the Manned Space-Laboratories for operational specific tasks like system simulation, training of teleoperators, parallel operation simultaneously to actual in-orbit activities and for the verification of the ground operations segment for telerobotics. The present status of definition for the facility functional and operational concept is described. Author

N90-29844*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

CONCEPT SYNTHESIS OF AN EQUIPMENT MANIPULATION AND TRANSPORTATION SYSTEM EMATS

W. dePeuter and E. Waffenschmidt (Dornier-Werke G.m.b.H., Friedrichshafen, Germany, F.R.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 135-143 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

The European Columbus Scenario is established. One of the Columbus Elements, the Man Tended Free Flyer will be designed for fully autonomous operation in order to provide the environment for micro gravity facilities. The Concept of an autonomous automation system which perform servicing of facilities and deals with related logistic tasks is discussed. Author

N90-29845*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FORCE-REFLECTIVE TELEOPERATED SYSTEM WITH SHARED AND COMPLIANT CONTROL CAPABILITIES

Z. Szakaly, W. S. Kim, and A. K. Bejczy *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 145-155 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

The force-reflecting teleoperator breadboard is described. It is the first system among available Research and Development

systems with the following combined capabilities: (1) The master input device is not a replica of the slave arm. It is a general purpose device which can be applied to the control of different robot arms through proper mathematical transformations. (2) Force reflection generated in the master hand controller is referenced to forces and moments measured by a six DOF force-moment sensor at the base of the robot hand. (3) The system permits a smooth spectrum of operations between full manual, shared manual and automatic, and full automatic (called traded) control. (4) The system can be operated with variable compliance or stiffness in force-reflecting control. Some of the key points of the system are the data handling and computing architecture, the communication method, and the handling of mathematical transformations. The architecture is a fully synchronized pipeline. The communication method achieves optimal use of a parallel communication channel between the local and remote computing nodes. A time delay box is also implemented in this communication channel permitting experiments with up to 8 sec time delay. The mathematical transformations are computed faster than 1 msec so that control at each node can be operated at 1 kHz servo rate without interpolation. This results in an overall force-reflecting loop rate of 200 Hz. Author

N90-29846*# Italian Space Agency, Rome.
INFORMATION MANAGEMENT IN AN INTEGRATED SPACE TELEROBOT **c63**
S. DiPippo, G. Pasquariello, and G. Sylos Labini *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 157-166 Prepared in cooperation with Istituto Elaborazione Segnali ed Immagini, Bari (Italy) (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

The in-orbit operations, like space structures inspection, servicing and repairing, is expected to be one of the most significant technological area for application and development of Robotics and Automation in Space Station environment. The Italian National Space Plan (PSN) has started up its strategic programme SPIDER (Space Inspection Device for Extravehicular Repairs), which is scheduled in three phases, with the final goal of performing docking and precision repairing in the Space Station environment. SPIDER system is an autonomous integrated space robot, using mature Artificial Intelligence tools and technics for its operational control. The preliminary results of a study on the information architecture of the spacecraft are described. Author

N90-29847*# Politecnico di Milano (Italy). Dept. of Mechanics.
REDUNDANCY IN SENSORS, CONTROL AND PLANNING OF A ROBOTIC SYSTEM FOR SPACE TELEROBOTICS
A. Rovetta, S. Vodret, and M. Bianchini *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 167-170 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The analysis and development of a manipulator redundant in structure and sensor devices controlled by a distributed multiprocessor architecture are discussed. The goal has been the realization of a modular structure of the manipulator with evident aspects of flexibility and transportability. The distributed control structure, thanks to his modularity and flexibility could be integrated in the future into an operative structure aimed to space telerobotics. The architecture is applied to the 6 DOF manipulator Gilberto. Author

N90-29848*# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.
HOW TO PUSH A BLOCK ALONG A WALL
Matthew T. Mason *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 173-182 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Some robot tasks require manipulation of objects that may be touching other fixed objects. The effects of friction and kinematic constraint must be anticipated, and may even be exploited to accomplish the task. An example task, a dynamic analysis, and appropriate effector motions are presented. The goal is to move a rectangular block along a wall, so that one side of the block maintains contact with the wall. Two solutions that push the block along the wall are discussed. Author

N90-29849*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GLOBAL MODELS: ROBOT SENSING, CONTROL, AND SENSORY-MOTOR SKILLS
Paul S. Schenker *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 183-186 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Robotics research has begun to address the modeling and implementation of a wide variety of unstructured tasks. Examples include automated navigation, platform servicing, custom fabrication and repair, deployment and recovery, and science exploration. Such tasks are poorly described at onset; the workspace layout is partially unfamiliar, and the task control sequence is only qualitatively characterized. The robot must model the workspace, plan detailed physical actions from qualitative goals, and adapt its instantaneous control regimes to unpredicted events. Developing robust representations and computational approaches for these sensing, planning, and control functions is a major challenge. The underlying domain constraints are very general, and seem to offer little guidance for well-bounded approximation of object shape and motion, manipulation postures and trajectories, and the like. This generalized modeling problem is discussed, with an emphasis on the role of sensing. It is also discussed that unstructured tasks often have, in fact, a high degree of underlying physical symmetry, and such implicit knowledge should be drawn on to model task performance strategies in a methodological fashion. A group-theoretic decomposition of the workspace organization, task goals, and their admissible interactions are proposed. This group-mechanical approach to task representation helps to clarify the functional interplay of perception and control, in essence, describing what perception is specifically for, versus how it is generically modeled. One also gains insight how perception might logically evolve in response to needs of more complex motor skills. It is discussed why, of the many solutions that are often mathematically admissible to a given sensory motor-coordination problem, one may be preferred over others. Author

N90-29850*# North Carolina State Univ., Raleigh. Robotics and Intelligent Systems Lab.
THE 3-D VISION SYSTEM INTEGRATED DEXTEROUS HAND
Ren C. Luo and Youn-Sik Han *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 187-195 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Most multifingered hands use a tendon mechanism to minimize the size and weight of the hand. Such tendon mechanisms suffer from the problems of striction and friction of the tendons resulting in a reduction of control accuracy. A design for a 3-D vision system integrated dexterous hand with motor control is described which overcomes these problems. The proposed hand is composed of three three-jointed grasping fingers with tactile sensors on their tips, a two-jointed eye finger with a cross-shaped laser beam emitting diode in its distal part. The two non-grasping fingers allow 3-D vision capability and can rotate around the hand to see and measure the sides of grasped objects and the task environment. An algorithm that determines the range and local orientation of the contact surface using a cross-shaped laser beam is introduced along with some potential applications. An efficient method for finger force calculation is presented which uses the measured contact surface normals of an object. M.G.

N90-29851*# Ohio State Univ., Columbus. Lab. for Artificial Intelligence Research.

A LAYERED ABDUCTION MODEL OF PERCEPTION: INTEGRATING BOTTOM-UP AND TOP-DOWN PROCESSING IN A MULTI-SENSE AGENT

John R. Josephson *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 197-206 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

A layered-abduction model of perception is presented which unifies bottom-up and top-down processing in a single logical and information-processing framework. The process of interpreting the input from each sense is broken down into discrete layers of interpretation, where at each layer a best explanation hypothesis is formed of the data presented by the layer or layers below, with the help of information available laterally and from above. The formation of this hypothesis is treated as a problem of abductive inference, similar to diagnosis and theory formation. Thus this model brings a knowledge-based problem-solving approach to the analysis of perception, treating perception as a kind of compiled cognition. The bottom-up passing of information from layer to layer defines channels of information flow, which separate and converge in a specific way for any specific sense modality. Multi-modal perception occurs where channels converge from more than one sense. This model has not yet been implemented, though it is based on systems which have been successful in medical and mechanical diagnosis and medical test interpretation. Author

N90-29852*# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.

RCTS: A FLEXIBLE ENVIRONMENT FOR SENSOR INTEGRATION AND CONTROL OF ROBOT SYSTEMS; THE DISTRIBUTED PROCESSING APPROACH

R. Allard, B. Mack, and M. M. Bayoumi *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 207-216 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

Most robot systems lack a suitable hardware and software environment for the efficient research of new control and sensing schemes. Typically, engineers and researchers need to be experts in control, sensing, programming, communication and robotics in order to implement, integrate and test new ideas in a robot system. In order to reduce this time, the Robot Controller Test Station (RCTS) has been developed. It uses a modular hardware and software architecture allowing easy physical and functional reconfiguration of a robot. This is accomplished by emphasizing four major design goals: flexibility, portability, ease of use, and ease of modification. An enhanced distributed processing version of RCTS is described. It features an expanded and more flexible communication system design. Distributed processing results in the availability of more local computing power and retains the low cost of microprocessors. A large number of possible communication, control and sensing schemes can therefore be easily introduced and tested, using the same basic software structure. Author

N90-29853*# Naval Postgraduate School, Monterey, CA. Dept. of Computer Science.

VEHICLE PATH-PLANNING IN THREE DIMENSIONS USING OPTICS ANALOGS FOR OPTIMIZING VISIBILITY AND ENERGY COST

Neil C. Rowe and David H. Lewis *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 217-226 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

Path planning is an important issue for space robotics. Finding safe and energy-efficient paths in the presence of obstacles and other constraints can be complex although important. High-level (large-scale) path planning for robotic vehicles was investigated in three-dimensional space with obstacles, accounting for: (1) energy costs proportional to path length; (2) turn costs where paths change trajectory abruptly; and (3) safety costs for the danger associated with traversing a particular path due to visibility or invisibility from a fixed set of observers. Paths optimal with respect to these cost factors are found. Autonomous or semi-autonomous vehicles were considered operating either in a space environment around satellites and space platforms, or aircraft, spacecraft, or smart missiles operating just above lunar and planetary surfaces. One class of applications concerns minimizing detection, as for example determining the best way to make complex modifications to a satellite without being observed by hostile sensors; another example is verifying there are no paths (holes) through a space defense system. Another class of applications concerns maximizing detection, as finding a good trajectory between mountain ranges of a planet while staying reasonably close to the surface, or finding paths for a flight between two locations that maximize the average number of triangulation points available at any time along the path. Author

N90-29854*# California Univ., Santa Barbara. Center for Robotic Systems in Microelectronics.

VACUUM MECHATRONICS

Susan Hackwood, Steven E. Belinski, and Gerardo Beni *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 229-240 (For primary document see N90-29830 24-54)

(Grants NSF CDR-84-21415; SRC88-MP-121)

Avail: NTIS HC A19/MF A03 CSCL 05H

The discipline of vacuum mechatronics is defined as the design and development of vacuum-compatible computer-controlled mechanisms for manipulating, sensing and testing in a vacuum environment. The importance of vacuum mechatronics is growing with an increased application of vacuum in space studies and in manufacturing for material processing, medicine, microelectronics, emission studies, lyophylisation, freeze drying and packaging. The quickly developing field of vacuum mechatronics will also be the driving force for the realization of an advanced era of totally enclosed clean manufacturing cells. High technology manufacturing has increasingly demanding requirements for precision manipulation, in situ process monitoring and contamination-free environments. To remove the contamination problems associated with human workers, the tendency in many manufacturing processes is to move towards total automation. This will become a requirement in the near future for e.g., microelectronics manufacturing. Automation in ultra-clean manufacturing environments is evolving into the concept of self-contained and fully enclosed manufacturing. A Self Contained Automated Robotic Factory (SCARF) is being developed as a flexible research facility for totally enclosed manufacturing. The construction and successful operation of a SCARF will provide a novel, flexible, self-contained, clean, vacuum manufacturing environment. SCARF also requires very high reliability and intelligent control. The trends in vacuum mechatronics and some of the key research issues are reviewed. Author

N90-29855*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

UNIFORM TASK LEVEL DEFINITIONS FOR ROBOTIC SYSTEM PERFORMANCE COMPARISONS

Charles Price and Delbert Tesar (Texas Univ., Austin.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 241-244 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

A series of ten task levels of increasing difficulty was compiled for use in comparative performance evaluations of available and future robotics technology. Each level has a breakdown of ten additional levels of difficulty to provide a layering of 100 levels. It is assumed that each level of task performance must be achieved by the system before it can be appropriately considered for the next level. Author

N90-29856*# Utah Univ., Salt Lake City. Center for Engineering Design.

LINEAR ANALYSIS OF A FORCE REFLECTIVE TELEOPERATOR

Klaus B. Biggers, Stephen C. Jacobsen, and Clark C. Davis *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 245-254 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

Complex force reflective teleoperation systems are often very difficult to analyze due to the large number of components and control loops involved. One mode of a force reflective teleoperator is described. An analysis of the performance of the system based on a linear analysis of the general full order model is presented. Reduced order models are derived and correlated with the full order models. Basic effects of force feedback and position feedback are examined and the effects of time delays between the master and slave are studied. The results show that with symmetrical position-position control of teleoperators, a basic trade off must be made between the intersystem stiffness of the teleoperator, and the impedance felt by the operator in free space. Author

N90-29857*# Lockheed Engineering and Sciences Co., Houston, TX.

REAL-TIME CARTESIAN FORCE FEEDBACK CONTROL OF A TELEOPERATED ROBOT

Perry Campbell *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 255-262 (For primary document see N90-29830 24-54)

(Contract NAS9-17900)

Avail: NTIS HC A19/MF A03 CSCL 05H

Active cartesian force control of a teleoperated robot is investigated. An economical microcomputer based control method was tested. Limitations are discussed and methods of performance improvement suggested. To demonstrate the performance of this technique, a preliminary test was performed with success. A general purpose bilateral force reflecting hand controller is currently being constructed based on this control method. Author

N90-29858*# Lockheed Engineering and Sciences Co., Houston, TX.

OPTIMAL PAYLOAD RATE LIMIT ALGORITHM FOR ZERO-G MANIPULATORS

M. L. Ross and D. A. McDermott *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 263-272 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

An algorithm for continuously computing safe maximum relative velocities for two bodies joined by a manipulator is discussed. The maximum velocities are such that if the brakes are applied at that instant, the ensuing travel between the bodies will be less than or equal to a predetermined amount. An improvement in the way this limit is computed for space manipulators is shown. The new method is explained, test cases are posed, and the results of these tests are displayed and discussed. Author

N90-29859*# IBM Italia, Rome. Scientific Center.

ASSEMBLY OF OBJECTS WITH NOT FULLY PREDEFINED SHAPES

M. A. Arlotti and V. DiMartino *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 273-282 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 05H

An assembly problem in a non-deterministic environment, i.e., where parts to be assembled have unknown shape, size and location, is described. The only knowledge used by the robot to perform the assembly operation is given by a connectivity rule and geometrical constraints concerning parts. Once a set of geometrical features of parts has been extracted by a vision system, applying such a rule allows the dtermination of the composition sequence. A suitable sensory apparatus allows the control the whole operation. Author

N90-29860*# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.

RECURSIVE MULTIBODY DYNAMICS AND DISCRETE-TIME OPTIMAL CONTROL **c63**

G. M. T. DEleuterio and C. J. Damaren *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 285-295 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 09B

A recursive algorithm is developed for the solution of the simulation dynamics problem for a chain of rigid bodies. Arbitrary joint constraints are permitted, that is, joints may allow translational and/or rotational degrees of freedom. The recursive procedure is shown to be identical to that encountered in a discrete-time optimal control problem. For each relevant quantity in the multibody dynamics problem, there exists an analog in the context of optimal control. The performance index that is minimized in the control problem is identified as Gibbs' function for the chain of bodies. Author

N90-29861*# Maryland Univ., College Park. Dept. of Mechanical Engineering.

THE EFFECTS OF GEAR REDUCTION ON ROBOT DYNAMICS **c37**

J. Chen *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 297-307 (For primary document see N90-29830 24-54)

(Grant NAG5-1019)

Avail: NTIS HC A19/MF A03 CSCL 13I

The effect of the joint drive system with gear reduction for a generic two-link system is studied. It is done by comparing the kinetic energy of such a system with that of a direct drive two-link system. The only difference are two terms involving the inertia of the motor rotor and gear ratio. Modifications of the equations of motion from a direct drive system are then developed and generalized to various cases encountered in robot manipulators. Author

N90-29862*# Lockheed Engineering and Sciences Co., Houston, TX.

RECURSIVE NEWTON-EULER FORMULATION OF MANIPULATOR DYNAMICS **c64**

M. G. Nasser *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 309-318 (For primary document see N90-29830 24-54)

Avail: NTIS HC A19/MF A03 CSCL 12A

A recursive Newton-Euler procedure is presented for the formulation and solution of manipulator dynamical equations. The procedure includes rotational and translational joints and a topological tree. This model was verified analytically using a planar two-link manipulator. Also, the model was tested numerically against the Walker-Orin model using the Shuttle Remote Manipulator System data. The hinge accelerations obtained from both models were identical. The computational requirements of the model vary linearly with the number of joints. The computational efficiency of this method exceeds that of Walker-Orin methods. This procedure may be viewed as a considerable generalization of Armstrong's method. A six-by-six formulation is adopted which enhances both the computational efficiency and simplicity of the model. Author

N90-29863*# San Diego State Univ., CA. Dept. of Mathematical Sciences.

KINEMATIC SENSITIVITY OF ROBOT MANIPULATORS **c64**

Marko I. Vuskovic *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 319-328 (For primary document see N90-29830

24-54)
Avail: NTIS HC A19/MF A03 CSCL 12A

Kinematic sensitivity vectors and matrices for open-loop, n degrees-of-freedom manipulators are derived. First-order sensitivity vectors are defined as partial derivatives of the manipulator's position and orientation with respect to its geometrical parameters. The four-parameter kinematic model is considered, as well as the five-parameter model in case of nominally parallel joint axes. Sensitivity vectors are expressed in terms of coordinate axes of manipulator frames. Second-order sensitivity vectors, the partial derivatives of first-order sensitivity vectors, are also considered. It is shown that second-order sensitivity vectors can be expressed as vector products of the first-order sensitivity vectors. Author

N90-29864*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EFFICIENT CONJUGATE GRADIENT ALGORITHMS FOR COMPUTATION OF THE MANIPULATOR FORWARD DYNAMICS **c61**
Amir Fijany and Robert E. Scheid *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 329-340 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

The applicability of conjugate gradient algorithms for computation of the manipulator forward dynamics is investigated. The redundancies in the previously proposed conjugate gradient algorithm are analyzed. A new version is developed which, by avoiding these redundancies, achieves a significantly greater efficiency. A preconditioned conjugate gradient algorithm is also presented. A diagonal matrix whose elements are the diagonal elements of the inertia matrix is proposed as the preconditioner. In order to increase the computational efficiency, an algorithm is developed which exploits the synergism between the computation of the diagonal elements of the inertia matrix and that required by the conjugate gradient algorithm. Author

N90-29865*# Pennsylvania Univ., Philadelphia. Dept. of Computer and Information Science.
ON THE STABILITY OF ROBOTIC SYSTEMS WITH RANDOM COMMUNICATION RATES
H. Kobayashi (Meiji Univ., Kawasaki, Japan), X. Yun, and R. P. Paul *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 341-350 Sponsored in part by NSF (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Control problems of sampled data systems which are subject to random sample rate variations and delays are studied. Due to the rapid growth of the use of computers more and more systems are controlled digitally. Complex systems such as space telerobotic systems require the integration of a number of subsystems at different hierarchical levels. While many subsystems may run on a single processor, some subsystems require their own processor or processors. The subsystems are integrated into functioning systems through communications. Communications between processes sharing a single processor are also subject to random delays due to memory management and interrupt latency. Communications between processors involve random delays due to network access and to data collisions. Furthermore, all control processes involve delays due to casual factors in measuring devices and to signal processing. Traditionally, sampling rates are chosen to meet the worst case communication delay. Such a strategy is wasteful as the processors are then idle a great proportion of the time; sample rates are not as high as possible resulting in poor performance or in the over specification of control processors; there is the possibility of missing data no matter how low the sample rate is picked. Asymptotical stability with probability one for randomly sampled multi-dimensional linear systems is studied. A sufficient condition for the stability is obtained. This condition is so simple that it can be applied to practical systems. A design procedure is also shown. Author

N90-29866*# Carnegie-Mellon Univ., Pittsburgh, PA. The Robotics Inst.
PRECEDENCE RELATIONSHIP REPRESENTATIONS OF MECHANICAL ASSEMBLY SEQUENCES
L. S. HomendeMello and A. C. Sanderson (Rensselaer Polytechnic Inst., Troy, NY.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 353-362 Sponsored in part by the Conselho Nacional de Desenvolvimento Cientifico e Tecnologico, Brazil; JPL; and Carnegie Mellon Univ. (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Two types of precedence relationship representations for mechanical assembly sequences are presented: precedence relationships between the establishment of one connection between two parts and the establishment of another connection, and precedence relationships between the establishment of one connection and states of the assembly process. Precedence relationship representations have the advantage of being very compact. The problem with these representations was how to guarantee their correctness and completeness. Two theorems are presented each of which leads to the generation of one type of precedence relationship representation guaranteeing its correctness and completeness for a class of assemblies. Author

N90-29867*# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Electrical, Computer, and Systems Engineering.
USING MULTIPLE SENSORS FOR PRINTED CIRCUIT BOARD INSERTION **c33**
Deepak Sood, Michael C. Repko, and Robert B. Kelley *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 363-372 (For primary document see N90-29830 24-54)
(Grants NAGw-1333; CCA8309/188)
Avail: NTIS HC A19/MF A03 CSCL 09C

As more and more activities are performed in space, there will be a greater demand placed on the information handling capacity of people who are to direct and accomplish these tasks. A promising alternative to full-time human involvement is the use of semi-autonomous, intelligent robot systems. To automate tasks such as assembly, disassembly, repair and maintenance, the issues presented by environmental uncertainties need to be addressed. These uncertainties are introduced by variations in the computed position of the robot at different locations in its work envelope, variations in part positioning, and tolerances of part dimensions. As a result, the robot system may not be able to accomplish the desired task without the help of sensor feedback. Measurements on the environment allow real time corrections to be made to the process. A design and implementation of an intelligent robot system which inserts printed circuit boards into a card cage are presented. Intelligent behavior is accomplished by coupling the task execution sequence with information derived from three different sensors: an overhead three-dimensional vision system, a fingertip infrared sensor, and a six degree of freedom wrist-mounted force/torque sensor. Author

N90-29868*# Honeywell, Inc., Minneapolis, MN.
DETERMINING ROBOT ACTIONS FOR TASKS REQUIRING SENSOR INTERACTION
John Budenske and Maria Gini (Minnesota Univ., Minneapolis.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 373-382 (For primary document see N90-29830 24-54)
(Grant NSF DMC-85-18735)
Avail: NTIS HC A19/MF A03 CSCL 05H

The performance of non-trivial tasks by a mobile robot has been a long term objective of robotic research. One of the major stumbling blocks to this goal is the conversion of the high-level planning goals and commands into the actuator and sensor processing controls. In order for a mobile robot to accomplish a non-trivial task, the task must be described in terms of primitive actions of the robot's actuators. Most non-trivial tasks require the robot to interact with its environment; thus necessitating

coordination of sensor processing and actuator control to accomplish the task. The main contention is that the transformation from the high level description of the task to the primitive actions should be performed primarily at execution time, when knowledge about the environment can be obtained through sensors. It is proposed to produce the detailed plan of primitive actions by using a collection of low-level planning components that contain domain specific knowledge and knowledge about the available sensors, actuators, and sensor/actuator processing. This collection will perform signal and control processing as well as serve as a control interface between an actual mobile robot and a high-level planning system. Previous research has shown the usefulness of high-level planning systems to plan the coordination of activities such to achieve a goal, but none have been fully applied to actual mobile robots due to the complexity of interacting with sensors and actuators. This control interface is currently being implemented on a LABMATE mobile robot connected to a SUN workstation and will be developed such to enable the LABMATE to perform non-trivial, sensor-intensive tasks as specified by a planning system. Author

N90-29869*# Oak Ridge National Lab., TN.
THE LABORATORY TELEROBOTIC MANIPULATOR PROGRAM
J. N. Herndon, S. M. Babcock, P. L. Butler, H. M. Costello, R. L. Glassell, R. L. Kress, D. P. Kuban, J. C. Rowe, and D. M. Williams *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 385-393 Sponsored in part by NASA, Langley Research Center (For primary document see N90-29830 24-54)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A19/MF A03 CSCL 05H

New opportunities for the application of telerobotic systems to enhance human intelligence and dexterity in the hazardous environment of space are presented by the NASA Space Station Program. Because of the need for significant increases in extravehicular activity and the potential increase in hazards associated with space programs, emphasis is being heightened on telerobotic systems research and development. The Laboratory Telerobotic Manipulator (LTM) program is performed to develop and demonstrate ground-based telerobotic manipulator system hardware for research and demonstrations aimed at future NASA applications. The LTM incorporates traction drives, modularity, redundant kinematics, and state-of-the-art hierarchical control techniques to form a basis for merging the diverse technological domains of robust, high-dexterity teleoperations and autonomous robotic operation into common hardware to further NASA's research. Author

N90-29870*# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
ROBOTIC CONTROL OF THE SEVEN-DEGREE-OF-FREEDOM NASA LABORATORY TELEROBOTIC MANIPULATOR
R. V. Dubey, J. A. Euler, R. B. Magness, S. M. Babcock, and J. N. Herndon (Oak Ridge National Lab., TN.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 395-407 Sponsored in part by NASA, Langley Research Center (For primary document see N90-29830 24-54)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A19/MF A03 CSCL 05H

A computationally efficient robotic control scheme for the NASA Laboratory Telerobotic Manipulator (LTM) is presented. This scheme utilizes the redundancy of the seven-degree-of-freedom LTM to avoid joint limits and singularities. An analysis to determine singular configurations is presented. Performance criteria are determined based on the joint limits and singularity analysis. The control scheme is developed in the framework of resolved rate control using the gradient projection method, and it does not require the generalized inverse of the Jacobian. An efficient formulation for determining the joint velocities of the LTM is obtained. This control scheme is well suited for real-time implementation, which is essential if the end-effector trajectory is continuously modified based on sensory feedback. Implementation of this scheme on a Motorola 68020 VME bus-based controller of the LTM is in progress. Simulation results demonstrating the redundancy utilization in the robotic mode are presented. Author

N90-29871*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
THE CONTROL OF SPACE MANIPULATORS SUBJECT TO SPACECRAFT ATTITUDE CONTROL SATURATION LIMITS
S. Dubowsky, E. E. Vance, and M. A. Torres *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 409-418 Sponsored by NASA, Langley Research Center (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The motions of robotic manipulators mounted on spacecraft can disturb the spacecraft's positions and attitude. These disturbances can surpass the ability of the system's attitude control reaction jets to control them, for the disturbances increase as manipulator speeds increase. If the manipulator moves too quickly the resulting disturbances can exceed the saturation levels of the reaction jets, causing excessive spacecraft motions. A method for planning space manipulator's motions is presented, so that tasks can be performed as quickly as possible without saturating the system's attitude control jets. Author

N90-29872*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SYSTEM ARCHITECTURES FOR TELEROBOTIC RESEARCH
F. Wallace Harrison *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 419-429 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Several activities are performed related to the definition and creation of telerobotic systems. The effort and investment required to create architectures for these complex systems can be enormous; however, the magnitude of process can be reduced if structured design techniques are applied. A number of informal methodologies supporting certain aspects of the design process are available. More recently, prototypes of integrated tools supporting all phases of system design from requirements analysis to code generation and hardware layout have begun to appear. Activities related to system architecture of telerobots are described, including current activities which are designed to provide a methodology for the comparison and quantitative analysis of alternative system architectures. Author

N90-29873*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPARISON OF JOINT SPACE VERSUS TASK FORCE LOAD DISTRIBUTION OPTIMIZATION FOR A MULTIARM MANIPULATOR SYSTEM
Donald I. Soloway and Thomas E. Alberts (Old Dominion Univ., Norfolk, VA.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 431-443 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

It is often proposed that the redundancy in choosing a force distribution for multiple arms grasping a single object should be handled by minimizing a quadratic performance index. The performance index may be formulated in terms of joint torques or in terms of the Cartesian space force/torque applied to the body by the grippers. The former seeks to minimize power consumption while the latter minimizes body stresses. Because the cost functions are related to each other by a joint angle dependent transformation on the weight matrix, it might be argued that either method tends to reduce power consumption, but clearly the joint space minimization is optimal. A comparison of these two options is presented with consideration given to computational cost and power consumption. Simulation results using a two arm robot system are presented to show the savings realized by employing the joint

space optimization. These savings are offset by additional complexity, computation time and in some cases processor power consumption. Author

N90-29874*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE NASA CONFERENCE ON SPACE TELEROBOTICS, VOLUME 5
Guillermo Rodriguez, ed. and Homayoun Seraji, ed. 31 Jan. 1989 428 p Conference held in Pasadena, CA, 31 Jan. - 2 Feb. 1989
(Contract NAS7-918)
(NASA-CR-186860; JPL-Publ-89-7-Vol-5; NAS 1.26:186860)
Avail: NTIS HC A19/MF A03 CSCL 05H

Papers presented at the NASA Conference on Space Telerobotics are compiled. The theme of the conference was man-machine collaboration in space. The conference provided a forum for researchers and engineers to exchange ideas on the research and development required for the application of telerobotics technology to the space systems planned for the 1990's and beyond. Volume 5 contains papers related to the following subject areas: robot arm modeling and control, special topics in telerobotics, telerobotic space operations, manipulator control, flight experiment concepts, manipulator coordination, issues in artificial intelligence systems, and research activities at the Johnson Space Center. For individual titles, see N90-29875 through N90-29912.

N90-29875*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TELEROBOTIC ACTIVITIES AT JOHNSON SPACE CENTER
Charles R. Price *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 3-7 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The Johnson Space Center telerobotic efforts span three major thrusts: (1) sustaining and expanding the capability of the Shuttle manipulator; (2) developing and integrating the multiple telerobotic system of the Space Station; and (3) fostering and applying research in all areas of telerobotics technology within the government, private, and academic sectors. Author

N90-29876*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
APPLICATION OF RECURSIVE MANIPULATOR DYNAMICS TO HYBRID SOFTWARE/HARDWARE SIMULATION
Christopher J. Hill, Kenneth A. Hopping (Boeing Electronics Co., Bellevue, WA.), and Charles R. Price *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 11-20 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Computer simulations of robotic mechanisms have traditionally solved the dynamic equations of motion for an N degree of freedom manipulator by formulating an N dimensional matrix equation combining the accelerations and torques (forces) for all joints. The use of an alternative formulation that is strictly recursive is described. The dynamic solution proceeds on a joint by joint basis, so it is possible to perform inverse dynamics at arbitrary joints. The dynamic formulation is generalized with respect to both rotational and translational joints, and it is also directly extendable to branched manipulator chains. A hardware substitution test is described in which a servo drive motor was integrated with a simulated manipulator arm. The form of the dynamic equation permits calculation of acceleration given torque or vice versa. Computing torque as a function of acceleration is required for the hybrid software/hardware simulation test described. For this test, a joint servo motor is controlled in conjunction with the simulation, and the dynamic torque on the servo motor is provided by a load motor on a common driveshaft. Author

N90-29877*# FMC Corp., Minneapolis, MN. Advanced Systems Center.
KINEMATICS AND CONTROL ALGORITHM DEVELOPMENT AND SIMULATION FOR A REDUNDANT TWO-ARM ROBOTIC MANIPULATOR SYSTEM c61
Michael P. Hennessey, Paul C. Huang, and Charles T. Bunnell *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 21-30 (For primary document see N90-29874 24-54)
(Contract DAAA19-87-0094)
Avail: NTIS HC A19/MF A03 CSCL 09B

An efficient approach to cartesian motion and force control of a 7 degree of freedom (DOF) manipulator is presented. It is based on extending the active stiffness controller to the 7 DOF case in general and use of an efficient version of the gradient projection technique for solving the inverse kinematics problem. Cooperative control is achieved through appropriate configuration of individual manipulator controllers. In addition, other aspects of trajectory generation using standard techniques are integrated into the controller. The method is then applied to a specific manipulator of interest (Robotics Research T-710). Simulation of the kinematics, dynamics, and control are provided in the context of several scenarios: one pertaining to a noncontact pick and place operation; one relating to contour following where contact is made between the manipulator and environment; and one pertaining to cooperative control. Author

N90-29878*# California Univ., Santa Barbara. Dept. of Mechanical Engineering.
INVERSE DYNAMICS OF A 3 DEGREE OF FREEDOM SPATIAL FLEXIBLE MANIPULATOR
Eduardo Bayo and M. Serna *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 31-40 Sponsored in part by NSF (For primary document see N90-29874 24-54)
(Contract NATO-0877-87)
Avail: NTIS HC A19/MF A03 CSCL 06H

A technique is presented for solving the inverse dynamics and kinematics of 3 degree of freedom spatial flexible manipulator. The proposed method finds the joint torques necessary to produce a specified end effector motion. Since the inverse dynamic problem in elastic manipulators is closely coupled to the inverse kinematic problem, the solution of the first also renders the displacements and rotations at any point of the manipulator, including the joints. Furthermore the formulation is complete in the sense that it includes all the nonlinear terms due to the large rotation of the links. The Timoshenko beam theory is used to model the elastic characteristics, and the resulting equations of motion are discretized using the finite element method. An iterative solution scheme is proposed that relies on local linearization of the problem. The solution of each linearization is carried out in the frequency domain. The performance and capabilities of this technique are tested through simulation analysis. Results show the potential use of this method for the smooth motion control of space telerobots. Author

N90-29879*# Tulane Univ., New Orleans, LA. Dept. of Electrical Engineering.
A CONTROL APPROACH FOR ROBOTS WITH FLEXIBLE LINKS AND RIGID END-EFFECTORS
Enrique Barbieri and Umit Ozguner (Ohio State Univ., Columbus.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 41-50 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 06H

Multiarm flexible robots with dexterous end effectors are currently being considered in such tasks as satellite retrieval, servicing and repair where a two phase problem can be identified: Phase 1, robot positioning in space; Phase 2, object retrieval. Some issues in Phase 1 regarding modelling and control strategies for a robotic system comprised of along flexible arm and a rigid three-link end effector are presented. The control objective is to maintain the last (rigid) link stationary in space in the presence of

an additive disturbance caused by the flexible energy in the first link after a positioning maneuver has been accomplished. Several configuration strategies can be considered, and optimal decentralized servocompensators can be designed. Preliminary computer simulations are included for a simple proportional controller to illustrate the approach. Author

N90-29880*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
PRESHAPING COMMAND INPUTS TO REDUCE TELEROBOTIC SYSTEM OSCILLATIONS **c63**
Neil C. Singer and Warren P. Seering *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 53-62 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

The results of using a new technique for shaping inputs to a model of the space shuttle Remote Manipulator System (RMS) are presented. The shapes inputs move the system to the same location that was originally commanded, however, the oscillations of the machine are considerably reduced. An overview of the new shaping method is presented. A description of RMS model is provided. The problem of slow joint servo rates on the RMS is accommodated with an extension of the shaping method. The results and sample data are also presented for both joint and three-dimensional cartesian motions. The results demonstrate that the new shaping method performs well on large, telerobotic systems which exhibit significant structural vibration. The new method is shown to also result in considerable energy savings during operations of the RMS manipulator. Author

N90-29881*# Aerospace Corp., El Segundo, CA.
PERFORMANCE CONSTRAINTS AND COMPENSATION FOR TELEOPERATION WITH DELAY **c63**
J. S. McLaughlin and B. D. Staunton *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 63-72 Sponsored by AF (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

A classical control perspective is used to characterize performance constraints and evaluate compensation techniques for teleoperation with delay. Use of control concepts such as open and closed loop performance, stability, and bandwidth yield insight to the delay problem. Teleoperator performance constraints are viewed as an open loop time delay lag and as a delay-induced closed loop bandwidth constraint. These constraints are illustrated with a simple analytical tracking example which is corroborated by a real time, 'man-in-the-loop' tracking experiment. The experiment also provides insight to those controller characteristics which are unique to a human operator. Predictive displays and feedforward commands are shown to provide open loop compensation for delay lag. Low pass filtering of telemetry or feedback signals is interpreted as closed loop compensation used to maintain a sufficiently low bandwidth for stability. A new closed loop compensation approach is proposed that uses a reactive (or force feedback) hand controller to restrict system bandwidth by impeding operator inputs. Author

N90-29882*# Lockheed Engineering and Management Services Co., Inc., Houston, TX.
FLIGHT TELEROBOTIC SERVICER CONTROL FROM THE ORBITER
Texas M. Ward and Don L. Harlan *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 73-80 (For primary document see N90-29874 24-54)
(Contract NAS9-17900)
Avail: NTIS HC A19/MF A03 CSCL 05H

The research and work conducted on the development of a testbed for a display and control panel for the Flight Telerobotic Servicer (FTS) are presented. Research was conducted on both software and hardware needed to control the FTS. A breadboard was constructed and placed into a mockup of the aft station of the Orbiter spacecraft. This breadboard concept was then evaluated using a computer graphics representation of the Tinman FTS. Extensive research was conducted on the software requirements and implementation. The hardware selected for the breadboard was 'flight like' and in some cases fit and function evaluated. The breadboard team studied some of the concepts without pursuing in depth their impact on the Orbiter or other missions. Assumptions are made concerning payload integration. Author

N90-29883*# New York Univ., New York. Robotics Research Lab.
TELEOPERATION EXPERIMENTS WITH A UTAH/MIT HAND AND A VPL DATAGLOVE
D. Clark, J. Demmel, J. Hong, Gerardo Lafferriere, L. Salkind, and X. Tan *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 81-89 (For primary document see N90-29874 24-54)
(Contracts NAG2-493; N00014-87-K-0129; CMU-406349-55586; NSF DCR-83-20085)
Avail: NTIS HC A19/MF A03 CSCL 05H

A teleoperation system capable of controlling a Utah/MIT Dextrous Hand using a VPL DataGlove as a master is presented. Additionally the system is capable of running the dextrous hand in robotic (autonomous) mode as new programs are developed. The software and hardware architecture used is presented and the experiments performed are described. The communication and calibration issues involved are analyzed and applications to the analysis and development of automated dextrous manipulations are investigated. Author

N90-29884*# Stanford Univ., CA.
INSTRUCTION DIALOGUES: TEACHING NEW SKILLS TO A ROBOT **c63**
Colleen Crangle and P. Suppes *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 91-101 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

Extended dialogues between a human user and a robot system are presented. The purpose of each dialogue is to teach the robot a new skill or to improve the performance of a skill it already has. The particular interest is in natural language dialogues but the illustrated techniques can be applied to any high level language. The primary purpose is to show how verbal instruction can be integrated with the robot's autonomous learning of a skill. Author

N90-29885*# Massachusetts Inst. of Tech., Cambridge.
INTERSET: A NATURAL LANGUAGE INTERFACE FOR TELEOPERATED ROBOTIC ASSEMBLY OF THE EASE SPACE STRUCTURE **c61**
Daniel K. Boorsma *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 103-108 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

A teleoperated robot was used to assemble the Experimental Assembly of Structures in Extra-vehicular activity (EASE) space structure under neutral buoyancy conditions, simulating a telerobot performing structural assembly in the zero gravity of space. This previous work used a manually controlled teleoperator as a test bed for system performance evaluations. From these results several Artificial Intelligence options were proposed. One of these was further developed into a real time assembly planner. The interface for this system is effective in assembling EASE structures using windowed graphics and a set of networked menus. As the problem space becomes more complex and hence the set of control options increases, a natural language interface may prove to be beneficial to supplement the menu based control strategy. This strategy can be beneficial in situations such as: describing the local environment, maintaining a data base of task event histories, modifying a plan

or a heuristic dynamically, summarizing a task in English, or operating in a novel situation. Author

N90-29886*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ESTABLISHING VIABLE TASK DOMAINS FOR TELEROBOT DEMONSTRATIONS **c63**
Wayne Zimmerman *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 111-120 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

A suite of telerobotic tasks has been compiled and assessed for the purpose of selecting viable tasks for near and far term laboratory demonstrations. The primary intent of developing the task is to provide some technical guidelines, with supporting data, for focusing laboratory demonstrations toward application domains that address a wide array of potential telerobot tasks and required technologies. This wide application would then result in a rich technology development environment to meet the broad task requirements of a system such as the Flight Telerobot Servicer. The methodology and results of the telerobot task assessment are described, including a ranking of the final select suite of major tasks. The presented along with guidelines for both interpreting the task ranking results and setting programmatic objectives based on these results. Detailed data about the task candidates and their respective levels of complexity, task primitive actions, and the actual relative measures of task worth as associated with key tradeoff variables such as cost, available research resources, technology availability, and importance to the user community are also presented. Author

N90-29887*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE TELEROBOT WORKSTATION TESTBED FOR THE SHUTTLE AFT FLIGHT DECK: A PROJECT PLAN FOR INTEGRATING HUMAN FACTORS INTO SYSTEM DESIGN
Timothy Sauerwein *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 121-130 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The human factors design process in developing a shuttle orbiter aft flight deck workstation testbed is described. In developing an operator workstation to control various laboratory telerobots, strong elements of human factors engineering and ergonomics are integrated into the design process. The integration of human factors is performed by incorporating user feedback at key stages in the project life-cycle. An operator centered design approach helps insure the system users are working with the system designer in the design and operation of the system. The design methodology is presented along with the results of the design and the solutions regarding human factors design principles. Author

N90-29888*# Ministry of International Trade and Industry, Tokyo (Japan). Electrotechnical Lab.
MULTI-LEVEL MANUAL AND AUTONOMOUS CONTROL SUPERPOSITION FOR INTELLIGENT TELEROBOT **c63**
Shigeoki Hirai and T. Sato *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 131-140 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

Space telerobots are recognized to require cooperation with human operators in various ways. Multi-level manual and autonomous control superposition in telerobot task execution is described. The object model, the structured master-slave manipulation system, and the motion understanding system are proposed to realize the concept. The object model offers interfaces for task level and object level human intervention. The structured master-slave manipulation system offers interfaces for motion level human intervention. The motion understanding system maintains the consistency of the knowledge through all the levels which supports the robot autonomy while accepting the human intervention. The superposing execution of the teleoperational task at multi-levels realizes intuitive and robust task execution for wide variety of objects and in changeful environment. The performance of several examples of operating chemical apparatuses is shown. Author

N90-29889*# Sandia National Labs., Albuquerque, NM.
AN ALTERNATIVE CONTROL STRUCTURE FOR TELEROBOTICS
Peter T. Boissiere and Raymond W. Harrigan *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 141-150 Previously announced as N89-29751 (For primary document see N90-29874 24-54)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A19/MF A03 CSCL 05H

A new teletobotic control concept which couples human supervisory commands with computer reasoning is presented. The control system is responsive and accomplishes an operator's commands while providing obstacle avoidance and stable controlled interactions with the environment in the presence of communication time delays. This provides a system which not only assists the operator in accomplishing tasks but modifies inappropriate operator commands which can result in safety hazards and/or equipment damage. Author

N90-29890*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
INTEGRATION OF A SENSOR BASED MULTIPLE ROBOT ENVIRONMENT FOR SPACE APPLICATIONS: THE JOHNSON SPACE CENTER TELEOPERATOR BRANCH ROBOTICS LABORATORY
James Hwang, Perry Campbell, Mike Ross (Lockheed Engineering and Management Services Co., Inc., Houston, TX.), Charles R. Price, and Don Barron *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 151-160 (For primary document see N90-29874 24-54)
(Contract NAS9-1900)
Avail: NTIS HC A19/MF A03 CSCL 05H

An integrated operating environment was designed to incorporate three general purpose robots, sensors, and end effectors, including Force/Torque Sensors, Tactile Array sensors, Tactile force sensors, and Force-sensing grippers. The design and implementation of: (1) the teleoperation of a general purpose PUMA robot; (2) an integrated sensor hardware/software system; (3) the force-sensing gripper control; (4) the host computer system for dual Robotic Research arms; and (5) the Ethernet integration are described. Author

N90-29891*# National Inst. of Standards and Technology, Gaithersburg, MD.
REQUIREMENTS FOR IMPLEMENTING REAL-TIME CONTROL FUNCTIONAL MODULES ON A HIERARCHICAL PARALLEL PIPELINED SYSTEM **c63**
Thomas E. Wheatley, John L. Michaloski, and Ronald Lumia *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 163-172 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

Analysis of a robot control system leads to a broad range of processing requirements. One fundamental requirement of a robot control system is the necessity of a microcomputer system in order to provide sufficient processing capability.The use of multiple processors in a parallel architecture is beneficial for a number of reasons, including better cost performance, modular growth, increased reliability through replication, and flexibility for testing alternate control strategies via different partitioning. A survey of the progression from low level control synchronizing primitives to higher level communication tools is presented. The system communication and control mechanisms of existing robot control systems are compared to the hierarchical control model. The impact

of this design methodology on the current robot control systems is explored. Author

N90-29892*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL TELEROBOTIC MANIPULATOR CONTROL AND MECHANIZATION (MCM) SUBSYSTEM c37
Samad Hayati, Thomas S. Lee, Kam Tso, Paul Backes, Edwin Kan, and J. Lloyd (McGill Univ., Montreal, Quebec) *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 173-182 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 13I

The Manipulator Control and Mechanization (MCM) subsystem of the telerobot system provides the real-time control of the robot manipulators in autonomous and teleoperated modes and real time input/output for a variety of sensors and actuators. Substantial hardware and software are included in this subsystem which interfaces in the hierarchy of the telerobot system with the other subsystems. The other subsystems are: run time control, task planning and reasoning, sensing and perception, and operator control subsystem. The architecture of the MCM subsystem, its capabilities, and details of various hardware and software elements are described. Important improvements in the MCM subsystem over the first version are: dual arm coordinated trajectory generation and control, addition of integrated teleoperation, shared control capability, replacement of the ultimate controllers with motor controllers, and substantial increase in real time processing capability. Author

N90-29893*# Chicago Univ., IL. Dept. of Electrical Engineering and Computer Science.
ON DISCRETE CONTROL OF NONLINEAR SYSTEMS WITH APPLICATIONS TO ROBOTICS
Mansour Eslami *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 183-191 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Much progress has been reported in the areas of modeling and control of nonlinear dynamic systems in a continuous-time framework. From implementation point of view, however, it is essential to study these nonlinear systems directly in a discrete setting that is amenable for interfacing with digital computers. But to develop discrete models and discrete controllers for a nonlinear system such as robot is a nontrivial task. Robot is also inherently a variable-inertia dynamic system involving additional complications. Not only the computer-oriented models of these systems must satisfy the usual requirements for such models, but these must also be compatible with the inherent capabilities of computers and must preserve the fundamental physical characteristics of continuous-time systems such as the conservation of energy and/or momentum. Preliminary issues regarding discrete systems in general and discrete models of a typical industrial robot that is developed with full consideration of the principle of conservation of energy are presented. Some research on the pertinent tactile information processing is reviewed. Finally, system control methods and how to integrate these issues in order to complete the task of discrete control of a robot manipulator are also reviewed. Author

N90-29894*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A SPATIAL OPERATOR ALGEBRA FOR MANIPULATOR MODELING AND CONTROL c64
G. Rodriguez, Kenneth Kreutz, and Abhinandan Jain *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 193-204 Previously announced in IAA as A89-53452 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 12A

A recently developed spatial operator algebra, useful for modeling, control, and trajectory design of manipulators is discussed. The elements of this algebra are linear operators whose domain and range spaces consist of forces, moments, velocities, and accelerations. The effect of these operators is equivalent to a spatial recursion along the span of a manipulator. Inversion of operators can be efficiently obtained via techniques of recursive filtering and smoothing. The operator algebra provides a high level framework for describing the dynamic and kinematic behavior of a manipulator and control and trajectory design algorithms. The interpretation of expressions within the algebraic framework leads to enhanced conceptual and physical understanding of manipulator dynamics and kinematics. Furthermore, implementable recursive algorithms can be immediately derived from the abstract operator expressions by inspection. Thus, the transition from an abstract problem formulation and solution to the detailed mechanizaton of specific algorithms is greatly simplified. The analytical formulation of the operator algebra, as well as its implementation in the Ada programming language are discussed. Author

N90-29895*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FLIGHT EXPERIMENTS IN TELEROBOTICS-ORBITER MIDDECK CONCEPT
Lyle M. Jenkins *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 207-213 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Most uncertainties of operation of a telerobot in the space environment relate to the absence of gravity effects and not to the vacuum effects. A flight experiment concept is proposed for the middeck of the space shuttle that provides direct access for the crew. Telerobot dextrous manipulation issues in task performance, mechanism response, system duty cycles, and operator interface can be effectively addressed. A pair of replica-type master controllers would be adapted for slave manipulator functions. A variety of test setups and control modes can obtain data on zero G operation of a telerobot. Author

N90-29896*# Tokyo Inst. of Tech. (Japan). Dept. of Mechanical Engineering Science.
EXPERIMENTAL STUDY ON TWO-DIMENSIONAL FREE-FLYING ROBOT SATELLITE MODEL c18
Yoji Umetani and Kazuya Yoshida *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 215-224 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 22B

The experimental study on a control method for a free flying space robotic arm was treated by means of a two-dimensional laboratory model. The main target is to develop a new control method for trajectory tracking or target capturing, considering dynamical interaction between the manipulator arm and the base vehicle in space micro-gravity environment. In order to simulate the micro-gravity environment mechanically, a laboratory model of a robot satellite supported on air bearings was developed. The model comprises a base equipped with power and air supplies and a two-link manipulator arm. This model has relatively low gravitational and frictional disturbance in planar motion. An on-line resolved motion rate control scheme with vision feedback is developed for experimenting capture operations. The scheme utilizes the Generalized Jacobian Matrix. In experiment, the acceleration environment of the model is evaluated firstly, then target capture operations are examined. The manipulator can properly chase and capture both a standing target and a moving target in spite of complex satellite/manipulator dynamical interactions. The experimental results confirm the validity of the Generalized Jacobian Matrix concept and the proposed control method. Author

N90-29897*# Advanced Decision Systems, Mountain View, CA.
THE ASTRONAUT AND THE BANANA PEEL: AN EVA RETRIEVER SCENARIO
Daniel G. Shapiro *In* JPL, California Inst. of Tech., Proceedings

of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 225-234 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

To prepare for the problem of accidents in Space Station activities, the Extravehicular Activity Retriever (EVAR) robot is being constructed, whose purpose is to retrieve astronauts and tools that float free of the Space Station. Advanced Decision Systems is at the beginning of a project to develop research software capable of guiding EVAR through the retrieval process. This involves addressing problems in machine vision, dexterous manipulation, real time construction of programs via speech input, and reactive execution of plans despite the mishaps and unexpected conditions that arise in uncontrolled domains. The problem analysis phase of this work is presented. An EVAR scenario is used to elucidate major domain and technical problems. An overview of the technical approach to prototyping an EVAR system is also presented. Author

N90-29898*# Stanford Univ., CA. Aerospace Robotics Lab.
COMPUTED TORQUE CONTROL OF A FREE-FLYING COOPERAT ING-ARM ROBOT
Ross Koningstein, Marc Ullman, and Robert H. Cannon, Jr. *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 235-243 (For primary document see N90-29874 24-54)
(Contract NCC2-333)
Avail: NTIS HC A19/MF A03 CSCL 05H

The unified approach to solving free-floating space robot manipulator end-point control problems is presented using a control formulation based on an extension of computed torque. Once the desired end-point accelerations have been specified, the kinematic equations are used with momentum conservation equations to solve for the joint accelerations in any of the robot's possible configurations: fixed base or free-flying with open/closed chain grasp. The joint accelerations can then be used to calculate the arm control torques and internal forces using a recursive order N algorithm. Initial experimental verification of these techniques has been performed using a laboratory model of a two-armed space robot. This fully autonomous spacecraft system experiences the drag-free, zero G characteristics of space in two dimensions through the use of an air cushion support system. Results of these initial experiments are included which validate the correctness of the proposed methodology. The further problem of control in the large where not only the manipulator tip positions but the entire system consisting of base and arms must be controlled is also presented. The availability of a physical testbed has brought a keener insight into the subtleties of the problem at hand.
Author

N90-29899*# Tsukuba Space Center (Japan).
NEXT GENERATION SPACE ROBOT
Tsutomu Iwata, Mitsushige Oda, and Ryoichi Imai *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 245-252 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The recent research effort on the next generation space robots is presented. The goals of this research are to develop the fundamental technologies and to acquire the design parameters of the next generation space robot. Visual sensing and perception, dexterous manipulation, man machine interface and artificial intelligence techniques such as task planning are identified as the key technologies. Author

N90-29900*# Drexel Univ., Philadelphia, PA. Dept. of Electrical and Computer Engineering.
COORDINATION IN A HIERARCHICAL MULTI-ACTUATOR CONTROLLER
Alex Meystel *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 255-262 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

A hierarchical multi-actuator controller is represented as a multi-resolutional information (knowledge) system utilizing a number of intelligent modules with decision making capabilities. The laws of multi-resolutional information (knowledge) organization and processing are presumed to be satisfied including the rules of dealing with redundant knowledge. A general case is considered in which a process to be controlled by a multiplicity of actuators is a distributed one and the condition of distribution can be formulated analytically. Operation of a lumped multi-actuator process is a particular case which has a broad practical application. Author

N90-29901*# Bureau of Mines, Pittsburgh, PA.
DISTRIBUTED COMMUNICATIONS AND CONTROL NETWORK FOR ROBOTIC MINING
William H. Schiffbauer *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 263-272 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The application of robotics to coal mining machines is one approach pursued to increase productivity while providing enhanced safety for the coal miner. Toward that end, a network composed of microcontrollers, computers, expert systems, real time operating systems, and a variety of program languages are being integrated that will act as the backbone for intelligent machine operation. Actual mining machines, including a few customized ones, have been given telerobotic semiautonomous capabilities by applying the described network. Control devices, intelligent sensors and computers onboard these machines are showing promise of achieving improved mining productivity and safety benefits. Current research using these machines involves navigation, multiple machine interaction, machine diagnostics, mineral detection, and graphical machine representation. Guidance sensors and systems employed include: sonar, laser rangers, gyroscopes, magnetometers, clinometers, and accelerometers. Information on the network of hardware/software and its implementation on mining machines are presented. Anticipated coal production operations using the network are discussed. A parallelism is also drawn between the direction of present day underground coal mining research to how the lunar soil (regolith) may be mined. A conceptual lunar mining operation that employs a distributed communication and control network is detailed. Author

N90-29902*# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
COMPUTER SIMULATION AND DESIGN OF A THREE DEGREE-OF-FREEDOM SHOULDER MODULE **c61**
David Marco, L. Torfason, and Delbert Tesar (Texas Univ., Austin.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 273-282 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

An in-depth kinematic analysis of a three degree of freedom fully-parallel robotic shoulder module is presented. The major goal of the analysis is to determine appropriate link dimensions which will provide a maximized workspace along with desirable input to output velocity and torque amplification. First order kinematic influence coefficients which describe the output velocity properties in terms of actuator motions provide a means to determine suitable geometric dimensions for the device. Through the use of computer simulation, optimal or near optimal link dimensions based on predetermined design criteria are provided for two different structural designs of the mechanism. The first uses three rotational inputs to control the output motion. The second design involves the use of four inputs, actuating any three inputs for a given position of the output link. Alternative actuator placements are examined to determine the most effective approach to control the output motion. Author

N90-29903*# Tecnospazio S.p.A., Milan (Italy).
A COLLISION AVOIDANCE SYSTEM FOR A SPACEPLANE MANIPULATOR ARM
Anna Sciomachen and Piergiovanni Magnani *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 283-291 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

Part of the activity in the area of collision avoidance related to the Hermes spaceplane is reported. A collision avoidance software system which was defined, developed and implemented in this project is presented. It computes the intersection between the solids representing the arm, the payload, and the objects. It is feasible with respect to the resources available on board, considering its performance. Author

N90-29904*# Ohio State Univ., Columbus. Dept. of Computer and Information Science.
GENERIC TASK PROBLEM SOLVERS IN SOAR c61
Todd R. Johnson, Jack W. Smith, Jr., and B. Chandrasekaran *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 295-300 (For primary document see N90-29874 24-54)
(Contract F30602-85-C-0010; HL-38776; AF-AFOSR-0255-82; LM-00083)
Avail: NTIS HC A19/MF A03 CSCL 09B

Two trends can be discerned in research in problem solving architectures in the last few years. On one hand, interest in task-specific architectures has grown, wherein types of problems of general utility are identified, and special architectures that support the development of problem solving systems for those types of problems are proposed. These architectures help in the acquisition and specification of knowledge by providing inference methods that are appropriate for the type of problem. However, knowledge based systems which use only one type of problem solving method are very brittle, and adding more types of methods requires a principled approach to integrating them in a flexible way. Contrasting with this trend is the proposal for a flexible, general architecture contained in the work on Soar. Soar has features which make it attractive for flexible use of all potentially relevant knowledge or methods. But as the theory Soar does not make commitments to specific types of problem solvers or provide guidance for their construction. It was investigated how task-specific architectures can be constructed in Soar to retain as many of the advantages as possible of both approaches. Examples were used from the Generic Task approach for building knowledge based systems. Though this approach was developed and applied for a number of problems, the ideas are applicable to other task-specific approaches as well. Author

N90-29905*# Institut National de Recherche d'Informatique et d'Automatique, Rennes (France).
TEMPORAL LOGICS MEET TELEROBOTICS
Eric Rutten and Lionel Marce *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 301-310 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The specificity of telerobotics being the presence of a human operator, decision assistance tools are necessary for the operator, especially in hostile environments. In order to reduce execution hazards due to a degraded ability for quick and efficient recovery of unexpected dangerous situations, it is of importance to have the opportunity, amongst others, to simulate the possible consequences of a plan before its actual execution, in order to detect these problematic situations. Hence the idea of providing the operator with a simulator enabling him to verify the temporal and logical coherence of his plans. Therefore, the power of logical formalisms is used for representation and deduction purposes. Starting from the class of situations that are represented, a STRIPS (the STanford Research Institute Problem Solver)-like formalism and its underlying logic are adapted to the simulation of plans of actions in time. The choice of a temporal logic enables to build a world representation, on which the effects of plans, grouping actions into control structures, will be transcribed by the simulation, resulting in a verdict and information about the plan's coherence. Author

N90-29906*# Martin Marietta Aerospace, Denver, CO. Astronautics Group.
AN EFFICIENT TEMPORAL LOGIC FOR ROBOTIC TASK PLANNING c63
Jeffrey M. Becker *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 311-320 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

Computations required for temporal reasoning can be prohibitively expensive if fully general representations are used. Overly simple representations, such as totally ordered sequence of time points, are inadequate for use in a nonlinear task planning system. A middle ground is identified which is general enough to support a capable nonlinear task planner, but specialized enough that the system can support online task planning in real time. A Temporal Logic System (TLS) was developed during the Intelligent Task Automation (ITA) project to support robotic task planning. TLS is also used within the ITA system to support plan execution, monitoring, and exception handling. Author

N90-29907*# Centre National de la Recherche Scientifique, Toulouse (France).
THE INDEXED TIME TABLE APPROACH FOR PLANNING AND ACTING
Malik Ghallab and Amine Mounir Alaoui *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 321-332 Sponsored in part by EEC and by French National Research Program (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

A representation is discussed of symbolic temporal relations, called IxTeT, that is both powerful enough at the reasoning level for tasks such as plan generation, refinement and modification, and efficient enough for dealing with real time constraints in action monitoring and reactive planning. Such representation for dealing with time is needed in a teleoperated space robot. After a brief survey of known approaches, the proposed representation shows its computational efficiency for managing a large data base of temporal relations. Reactive planning with IxTeT is described and exemplified through the problem of mission planning and modification for a simple surveying satellite. Author

N90-29908*# Rochester Univ., NY. Dept. of Computer Science.
REACTIVE BEHAVIOR, LEARNING, AND ANTICIPATION
Steven D. Whitehead and Dana H. Ballard *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 333-344 (For primary document see N90-29874 24-54)
(Grants NSF DCR-86-02958; R01-NS22407-01)
Avail: NTIS HC A19/MF A03 CSCL 05H

Reactive systems always act, thinking only long enough to 'look up' the action to execute. Traditional planning systems think a lot, and act only after generating fairly precise plans. Each represents an endpoint on a spectrum. It is argued that primitive forms of reasoning, like anticipation, play an important role in reducing the cost of learning and that the decision to act or think should be based on the uncertainty associated with the utility of executing an action in a particular situation. An architecture for an adaptable reactive system is presented and it is shown how it can be augmented with a simple anticipation mechanism that can substantially reduce the cost and time of learning. Author

N90-29909*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SHUTTLE REMOTE MANIPULATOR SYSTEM MISSION PREPARATION AND OPERATIONS

Ernest E. Smith, Jr. *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 347-351 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The preflight planning, analysis, procedures development, and operations support for the Space Transportation System payload deployment and retrieval missions utilizing the Shuttle Remote Manipulator System are summarized. Analysis of the normal operational loads and failure induced loads and motion are factored into all procedures. Both the astronaut flight crews and the Mission Control Center flight control teams receive considerable training for standard and mission specific operations. The real time flight control team activities are described. Author

N90-29910*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A COMPARISON OF THE SHUTTLE REMOTE MANIPULATOR SYSTEM AND THE SPACE STATION FREEDOM MOBILE SERVICING CENTER
Edith C. Taylor and Michael Ross (Lockheed Engineering and Sciences Co., Houston, TX.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 353-361 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The Shuttle Remote Manipulator System is a mature system which has successfully completed 18 flights. Its primary functional design driver was the capability to deploy and retrieve payloads from the Orbiter cargo bay. The Space Station Freedom Mobile Servicing Center is still in the requirements definition and early design stage. Its primary function design drivers are the capabilities: to support Space Station construction and assembly tasks; to provide external transportation about the Space Station; to provide handling capabilities for the Orbiter, free flyers, and payloads; to support attached payload servicing in the extravehicular environment; and to perform scheduled and un-scheduled maintenance on the Space Station. The differences between the two systems in the area of geometric configuration, mobility, sensor capabilities, control stations, control algorithms, handling performance, end effector dexterity, and fault tolerance are discussed. Author

N90-29911*# Lockheed Engineering and Sciences Co., Houston, TX.
DEXTEROUS MANIPULATOR FLIGHT DEMONSTRATION
Edward L. Carter *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 363-372 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 05H

The Dexterous Manipulator Flight Experiment, an outgrowth of the Dexterous End Effector project, is an experiment to demonstrate newly developed equipment and methods that make for a dexterous manipulator which can be used on the Space Shuttle or other space missions. The goals of the project, the objectives of the flight experiment, the experiment equipment, and the tasks to be performed during the demonstration are discussed. Author

N90-29912*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AN INTELLIGENT, FREE-FLYING ROBOT **c18**
G. J. Reuter, C. W. Hess, D. E. Rhoades, L. W. McFadin, K. J. Healey, J. D. Erickson, and Dale E. Phinney (Lockheed Engineering and Sciences Co., Houston, TX.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 373-379 Previously announced in IAA as A90-10354 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 22B

The ground based demonstration of the extensive extravehicular activity (EVA) Retriever, a voice-supervised, intelligent, free flying robot, is designed to evaluate the capability to retrieve objects (astronauts, equipment, and tools) which have accidentally separated from the Space Station. The major objective of the EVA Retriever Project is to design, develop, and evaluate an integrated robotic hardware and on-board software system which autonomously: (1) performs system activation and check-out; (2) searches for and acquires the target; (3) plans and executes a rendezvous while continuously tracking the target; (4) avoids stationary and moving obstacles; (5) reaches for and grapples the target; (6) returns to transfer the object; and (7) returns to base. Author

N90-29913# Naval Weapons Center, China Lake, CA. Aircraft Weapons Integration Dept.
MULTISENSOR EVALUATION FRAMEWORK Summary Report, May 1986 - Aug. 1989
David C. Foyle Sep. 1989 29 p
(AD-A224271; AD-E900951; NWC-TP-7027) Avail: NTIS HC A03/MF A01 CSCL 17/11

Based on existing integration models in the literature, an evaluation framework is developed to assess the operator's ability to use multisensor, or sensor fusion, displays. GRA

N90-29914# International Atomic Energy Agency, Vienna (Austria).
FACTORS AFFECTING PRACTICAL APPLICATION OF FOOD IRRADIATION
Apr. 1990 88 p Presented at the Advisory Group Meeting on Commercial Use of Food Irradiation, Vienna, Austria, 27 Jun. 1988 Prepared in cooperation with Food and Agriculture Organization of the United Nations, Rome, Italy
(DE90-631277; IAEA-TECDOC-544; CONF-8806477) Avail: NTIS (US Sales Only) HC A05/MF A01

An Advisory Group Meeting on Commercial Use of Food Irradiation was convened in order to discuss problems of the industry's acceptance of food irradiation and their remedies. Senior executives from major food industries, trade and consumer organizations were invited to discuss these problems and to prepare a report which would serve as the basis for a future plan of action by sponsoring organizations in the field of food irradiation. This publication contains the report of the meeting, papers presented by the participants and their recommendations to the sponsoring organizations. DOE

N90-29915# International Atomic Energy Agency, Vienna (Austria).
HUMAN ERROR CLASSIFICATION AND DATA COLLECTION
Jan. 1990 172 p Presented at the Technical Committee on Human Error Classification and Data Collection, Vienna, Austria, 20-24 Feb. 1989
(DE90-631408; IAEA-TECDOC-538; CONF-8902182) Avail: NTIS (US Sales Only) HC A08/MF A01

Analysis of human error data requires human error classification. As the human factors/reliability subject has developed, so too has the topic of human error classification. The classifications vary considerably depending on whether it has been developed from a theoretical psychological approach to understanding human behavior or error, or whether it has been based on an empirical practical approach. This latter approach is often adopted by nuclear power plants that need to make practical improvements as soon as possible. This document will review aspects of human error classification and data collection in order to show where potential improvements could be made. It will attempt to show why there are problems with human error classification and data collection schemes and that these problems will not be easy to resolve. The Annex of this document contains the papers presented at the meeting. A separate abstract was prepared for each of these 12 papers. DOE

N90-29916# Army Aeromedical Research Lab., Fort Rucker, AL. Biomedical Applications Div.
VISUAL PROCESSING: IMPLICATIONS FOR HELMET MOUNTED DISPLAYS Report, Oct. 1989 - Apr. 1990
Jo L. Caldwell, Rhonda L. Cornum, Robert L. Stephens, and

Clarence E. Rash May 1990 18 p Presented at the SPIE 1990 Technical Symposium on Aerospace Sensing, 16-20 Apr. 1990 Submitted for publication
(AD-A223488; USAARL-90-11) Avail: NTIS HC A03/MF A01 CSCL 25/3

A study was conducted to compare the performance of AH-64 (Apache) pilots to other Army pilots on visual tasks. Each pilot was given a task presented monocularly to the right eye, a task presented monocularly to the left eye, and a task presented to both eyes simultaneously in a dichotic task. Results indicated no performance difference between the groups of pilots on the dichotic task, but indicated better performance on the left monocular task for the AH-64 pilots. These results indicate that AH-64 pilots who are required to switch their attention from their left eyes to their right eyes in order to obtain needed information are capable of processing information efficiently and effectively using only one eye. The implications of these results for the Integrated Helmet and Display Sighting System (IHADSS) are discussed. GRA

N90-29917# Sandia National Labs., Albuquerque, NM.
OXYGEN DEFICIENCY MONITOR SYSTEM
Gary L. Devlin (Ktech Corp., Albuquerque, NM.) 12 May 1990 24 p
(Contract DE-AC04-76DP-00789)
(DE90-014866; SAND-90-1955) Avail: NTIS HC A03/MF A01

This report describes the components and installation of the Oxygen Deficiency Monitor System (ODMS) at the Simulation Technology Laboratory (STL) at Sandia National Laboratories. The ODMS presently monitors the oxygen concentration of the ambient air in the lower levels of the laboratory where air circulation may be insufficient to disperse gases that may settle and accumulate creating an oxygen-deficient environment. The intent of this report is to provide a general introduction to the system for personnel involved in the maintenance and modifications of the system and may be useful to people interested in installing a similar system. This will report describe the hardware components, installation considerations, operation, and maintenance of the system. DOE

N90-29918# Bertin et Cie., Plaisir (France). Dept. Surete de Fonctionnement.
PRELIMINARY HAZARD ANALYSIS IN DESIGN APPLICATION TO EVA SPACE SUIT
T. Boucon and R. Chase (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) 1990 3 p In FRENCH; ENGLISH summary Presented at the 7th International Conference on Reliability and Maintainability, Brest, France, 18-23 Jun. 1990
(ETN-90-97585) Avail: NTIS HC A01/MF A01

The method developed for the analysis of hazards during the design steps of a system is described. The method takes into account material and human risks. An application example concerning the Extra Vehicular Activity (EVA) suit is presented. The results of the analysis, the hazard scenarios and recommendations are included. ESA

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N90-29919*# Wyle Labs., Inc., Hampton, VA.
REALTIME MULTI-PLOT GRAPHICS SYSTEM
Michael S. Shipkowski Washington Sep. 1990 47 p
(Contract NAS1-18304)
(NASA-CR-4304; NAS 1.26:4304) Avail: NTIS HC A03/MF A01 CSCL 09B

The increased complexity of test operations and customer requirements at Langley Research Center's National Transonic Facility (NTF) surpassed the capabilities of the initial realtime graphics system. The analysis of existing hardware and software and the enhancements made to develop a new realtime graphics system are described. The result of this effort is a cost effective system, based on hardware already in place, that support high speed, high resolution, generation and display of multiple realtime plots. The enhanced graphics system (EGS) meets the current and foreseeable future realtime graphics requirements of the NTF. While this system was developed to support wind tunnel operations, the overall design and capability of the system is applicable to other realtime data acquisition systems that have realtime plot requirements. Author

N90-29920# Wright State Univ., Dayton, OH. Dept. of Computer Science and Engineering.
A VHDL INTERFACE FOR ALTERA DESIGN FILES M.S. Thesis
Jerome Paul Nutter 1990 137 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224476; AFIT/CI/CIA-90-046) Avail: NTIS HC A07/MF A01 CSCL 12/5

Altera Erasable Programmable Logic Devices (EPLDs) are chips that can be custom designed. These EPLDs are individually described by their Altera Design Files (ADFs). The language structure of ADFs is not directly supported by the Very High Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL). VHDL is a software language that was selected as the IEEE standard for a hardware description language. A program is described that is capable of transforming an ADF into a VHDL entity declaration and entity structural architecture. The scope of ADFs the program transforms is limited to ADFs that contained only Altera primitives and are not of the State Machine Format. The transformation program was developed on a Personal Computer (PC) and the programming language used was Turbo C by Borland. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N90-29921# Science Applications International Corp., McLean, VA.
SYSTEM SOFTWARE FOR SOVIET COMPUTERS

P. Wegner, J. Nestor, E. Schonberg, S. Smoliar, P. J. Weinberger, G. Widerhold, and P. Wolcott Aug. 1989 213 p
Avail: NTIS HC A10/MF A02

The range and capability of system software available for use on Soviet computers between 1984 and 1987 is examined. Programming languages, operating systems, networks, software engineering, software tools, database management systems, and artificial intelligence tools are discussed. The baseline for this study was the 1984 Foreign Applied Sciences Assessment Center report, Soviet Computer Science Research, (the Hammer study) which documented a considerable gap between the U.S. and Soviet computer capabilities. Author

N90-29922*# Cornell Univ., Ithaca, NY. ISIS Project.
PROGRAMMING YOUR WAY OUT OF THE PAST: ISIS AND THE META PROJECT
Kenneth P. Birman and Keith Marzullo 1989 15 p
(Contract NAG2-593; N00140-87-C-8904)
(NASA-CR-186275; NAS 1.26:186275) Avail: NTIS HC A03/MF A01 CSCL 09B

The ISIS distributed programming system and the META Project are described. The ISIS programming toolkit is an aid to low-level programming that makes it easy to build fault-tolerant distributed applications that exploit replication and concurrent execution. The META Project is reexamining high-level mechanisms such as the filesystem, shell language, and administration tools in distributed systems. Author

N90-29923# Helsinki Univ. (Finland). Dept. of Computer Science.
AHTO PROJECT: SOFTWARE TECHNOLOGY FOR OPEN DISTRIBUTED PROCESSING
T. Alanko, J. Keskinen, P. Kutvonen, M. Mutka, and M. Tienari Sep. 1989 66 p
(PB90-190943; ISBN-951-45-5111-7; A-1989-4) Avail: NTIS HC A04/MF A01 CSCL 09B

Presented here is an overview of the Open Distributed Processing Technology (AHTO) project, which is an approach to solving many of the problems of heterogeneous environments. The AHTO project has the goal to design and implement a software layer that provides a homogeneous interface to basic computing services for users of a heterogeneous environment. The interface is homogeneous at the programming and command level. Remote services and files can be accessed through the layer, and interprocess communication operations are provided to enable programmers to create distributed applications. The richness of a heterogeneous environment is preserved since only the interface is homogeneous. All the services of the AHTO layer will be implemented using the local operating system, and all objects remain directly accessible through the local operating system. To demonstrate and validate the principles of AHTO, a prototype will be implemented for an environment formed from OS/2, UNIX, and VMS operating systems. GRA

N90-29924# Department of Energy, Washington, DC.
DIGITAL COLOR REPRESENTATION Patent Application
James M. White, inventor (to DOE), Vance Faber, inventor (to DOE), and Jeffrey S. Saltzman, inventor (to DOE) (Los Alamos National Lab., NM.) 12 May 1989 19 p
(Contract W-7405-eng-36)
(DE90-014580; US-Patent-Appl-SN-350675;
Patents-US-A7350675) Avail: NTIS HC A03/MF A01

An image population having a large number of attributes is processed to form a display population with a predetermined smaller number of attributes which represent the larger number of attributes. In a particular application, the color values in an image are compressed for storage in a discrete lookup table (LUT) where an 8 bit data signal is enabled to form a display of 24 bit color values. The LUT is formed in a sampling and averaging process from the image color values with no requirement to define discrete Voronoi regions for color compression. Image color values are assigned 8 bit pointers to their closest LUT value whereby data processing requires only the 8 bit pointer value to provide 24 bit color values from the LUT. DOE

N90-29925*# Illinois Univ., Chicago. Dept. of Mathematics, Statistics, and Computer Science.
TREES, BIALGEBRAS AND INTRINSIC NUMERICAL ALGORITHMS
Peter Crouch, Robert Grossman, and Richard Larson May 1990 12 p Sponsored in part by EPRI
(Grants NAG2-513; NSF DMS-89-04740)
(NASA-CR-187031; NAS 1.26:187031; TR-LAC90-R23) Avail: NTIS HC A03/MF A01 CSCL 09B

Preliminary work about intrinsic numerical integrators evolving on groups is described. Fix a finite dimensional Lie group G; let g denote its Lie algebra, and let Y(sub 1),...,Y(sub N) denote a basis of g. A class of numerical algorithms is presented that approximate solutions to differential equations evolving on G of the form: dot-x(t) = F(x(t)), x(0) = p is an element of G. The algorithms depend upon constants c(sub i) and c(sub ij), for i = 1,...,k and j is less than i. The algorithms have the property that if the algorithm starts on the group, then it remains on the group. In addition, they also have the property that if G is the abelian group R(N), then the algorithm becomes the classical Runge-Kutta algorithm. The Cayley algebra generated by labeled, ordered trees is used to generate the equations that the coefficients c(sub i) and c(sub ij) must satisfy in order for the algorithm to yield an rth order numerical integrator and to analyze the resulting algorithms. M.G.

N90-29926# National Aeronautical Lab., Bangalore (India). Propulsion Div.
DEVELOPMENT OF A SOFTWARE PACKAGE FOR AUTOMATIC DATA ACQUISITION, ANALYSIS, AND CONTROLS IN AN AXIAL FLOW COMPRESSOR TEST RIG
Q. H. Nagpurwala and K. Rammohan (Regional Engineering Coll., Tiruchirapalli, India) Nov. 1989 18 p
(PD-PR-8910) Avail: NTIS HC A03/MF A01

A comprehensive multitasking software was developed for AUTOmatic Data Acquisition, Analysis, and Controls (AUTODAAC) in a high speed Axial Flow Compressor Research Rig. The software, written in BASIC, runs on a MACSYM 150 high speed desk-top computer which forms the heart of the instrumentation system attached to this test facility. The salient features and capabilities of AUTODAAC are discussed. Typical graphical outputs are also presented. Author

N90-29927# Yale Univ., New Haven, CT. Dept. of Computer Science.
STRATEGIES FOR TUTORING MULTIPLE BUGS Final Report, 15 Aug. 1985 - 15 Nov. 1988
David Carl Littman 18 May 1990 274 p
(Contract N00014-82-K-0714)
(AD-A223921) Avail: NTIS HC A12/MF A02 CSCL 05/8

A problem was investigated in the field of intelligent Tutoring Systems that has not been effectively addressed before. That problem is how to help students who need help with more than one error, or bug. For example, novice students who write computer programs rarely make a single bug. Rather, they come to their tutors with five, six, seven, or more bugs and they need help with all the bugs. Empirical observations of experienced human tutors show that they do not just jump in and start tutoring the first bug in the program. Instead, tutors formulate a tutorial plan for helping the student. Creating the tutorial plan requires the tutor to answer five tutorial planning decisions about each bug. The problem of multiple bugs was studied. Starting from empirical observations of experienced human tutors, a model was developed of the knowledge required to answer the five tutorial planning questions. The model is implemented as a computer program, TP, that can develop tutorial plans for multiple bugs that are as good as the tutorial plans generated by experienced human tutors. GRA

N90-29928# Naval Postgraduate School, Monterey, CA.
TURBO PASCAL IMPLEMENTATION OF A DISTRIBUTED PROCESSING NETWORK OF MS-DOS MICROCOMPUTERS CONNECTED IN A MASTER-SLAVE CONFIGURATION M.S. Thesis
Nelson C. Ard Dec. 1989 316 p
(AD-A223925) Avail: NTIS HC A14/MF A02 CSCL 12/7

The design and implementation is described of a distributed processing network of IBM PC compatible computers capable of performing parallel processing tasks. The network is a star cluster local network, with the central computer controlling the operations of the satellite computers on a sequential basis. The local area network software operates over the computer's standard RS-232C communications ports, and is currently implemented to allow the central computer to operate two satellite computers. Processing tasks are dispatched to the satellite computers as programs which run to completion on the satellite computers. Utility programs within the software include file and message transfer to start the programs on the satellite computers and to obtain the output of the remotely executed program, configuration utilities to set the communications port parameters, and windowing utilities for display of information normally presented on the remote computer's display. The program is implemented in Turbo Pascal 4.0 under the MS-DOS operating system, version 3.21. GRA

N90-29929# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
RECOGNITION BY LINEAR COMBINATION OF MODELS
Shimon Ullman and Ronen Basri (Weizmann Inst. of Science, Rehovoth, Israel) Aug. 1989 45 p
(Contracts N00014-86-K-0685; DACA76-85-C-0010; N00014-85-K-0124)
(AD-A224268; AI-M-1152) Avail: NTIS HC A03/MF A01 CSCL 12/9

Visual object recognition requires the matching of an image with a set of models stored in memory. An approach is proposed to recognition in which a 3-D object is represented by the linear combination of 2-D images of the object. If M is the set of pictures representing a given object, and P is the 2-D image of an object to be recognized, then P is considered an instance of M if P for some constants. It is shown that this approach handles correctly rigid 3-D transformations of objects with sharp as well as smooth boundaries, and can also handle non-rigid tranformations. It is shown that the variety of views depicting the same object under different transformations can often be expressed as the linear combinations of a small number of views. How this linear combination property may be used in the recognition process is suggested. GRA

N90-29930# Naval Weapons Center, China Lake, CA.
TUTORIAL ON USING LISP OBJECT-ORIENTED PROGRAMMING FOR BLACKBOARDS: SOLVING THE RADAR TRACKING PROBLEM Interim Report, Aug. 1986 - Aug. 1988
P. R. Kersten and A. C. Kak (Purdue Univ., West Lafayette, IN.) Aug. 1989 100 p
(AD-A224272; AD-E900939; NWC-TP-7004) Avail: NTIS HC A05/MF A01 CSCL 17/9

This report serves as a tutorial on how to use object-oriented programming in LISP to program a BB by explaining the important aspects of our radar tracking BB system. GRA

N90-29931# Honeywell, Inc., Bloomington, MN. Systems and Research Center.
OPTICAL SYMBOLIC PROCESSOR FOR EXPERT SYSTEM EXECUTION Final Technical Report, 1 Jun. 1986 - 31 Dec. 1989
Julian Bristow 31 Dec. 1989 248 p
(Contract F49620-86-C-0082; ARPA Order 5794)
(AD-A224284; AFOSR-90-0744TR) Avail: NTIS HC A11/MF A02 CSCL 12/5

The goal was to develop key concepts for optical symbolic computing. During the course of the program, both a top-down and bottom-up approach was taken to develop an architecture for symbolic computing. The approach was intended to result in an architecture suitable for the design goals while being implementable with practical components. Key results of the program include the following: Design of a unique symbolic processing architecture; Identification of lack of suitable addressable optical memory as a major impediment in the implementation of existing paradigms; Demonstration of a unique, critically needed polarization based modulator with 17 dB extinction ratio, and demonstration of the world's highest extinction ratio (23 dB) of AlGaAs/GaAs modulator at 1 GHz; and Demonstration of high density modulator arrays with the world's smallest pitch (20 um) and less than 20 dB crosstalk. GRA

N90-29932# Stanford Univ., CA. Dept. of Operations Research.
NEW APPROACHES TO LINEAR AND NONLINEAR PROGRAMMING Final Report, 1 Mar. 1987 - 28 Feb. 1989
Walter Murray and Michael A. Saunders Dec. 1989 9 p
(Grant AF-AFOSR-0196-87)
(AD-A224328; AFOSR-90-0662TR) Avail: NTIS HC A02/MF A01 CSCL 12/4

The theoretical properties and computational performance of techniques that solve linear and nonlinear programs by means of nonlinear transformations are studied. The group at the Systems Optimization Laboratory (SOL) were the first to recognize the connection between Karmarkar's (1984) projective method and the logarithmetic barrier method (see Gill, Murray, Saunders, Tomlin and Wright, 1986). It is now generally recognized that essentially all interior-point methods for linear programming inspired by Karmarkar's method are closely related to application of Newton's method to a sequence of barrier functions (see e.g., Gonzaga, 1987; Renegar, 1988, Anstreicher, 1988). Each barrier function is defined from the objective function and a barrier term that is infinite along the boundary of the feasible region. As the weight on the barrier term is reduced to zero, the solution of the subproblem becomes closer to the solution of the original problem. GRA

N90-29933# Naval Postgraduate School, Monterey, CA.
ISSUES IN EXPANDING THE SOFTWARE BASE MANAGEMENT SYSTEM SUPPORTING THE COMPUTER AIDED PROTOTYPING SYSTEM (CAPS) M.S. Thesis
James M. Huskins Jun. 1990 115 p
(Grant NSF CCR-87-10737)
(AD-A224344) Avail: NTIS HC A06/MF A01 CSCL 12/5

Reorganizing the Software Base Management System of the Computer Aided Prototyping System (CAPS) to take better advantage of object-oriented database technology, domain analysis and rule based systems is proposed. A method for using the Prototyping System Description Language (PSDL) augmented with domain dependent keywords to classify reusable Ada components and organize them in an object-oriented database is presented. A rule based structure needed to implement this software base is also described. Implementation of this structure is a goal for further research. GRA

N90-29934# Army Engineer Waterways Experiment Station, Vicksburg, MS. Information Technology Lab.
COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT: INVESTIGATION AND DESIGN OF U-FRAME STRUCTURES USING PROGRAM CUFRBC. VOLUME A: PROGRAM CRITERIA AND DOCUMENTATION Final Report
Clifford O. Hays, Jr. May 1990 139 p
(AD-A224387; WES/TR/ITL-90-3-Vol-A) Avail: NTIS HC A07/MF A01 CSCL 12/5

The interactive computer program CUFRBC can be used to investigate or design basins or channels for a variety of load conditions based on a two-dimensional frame analysis of a 1 ft slice of the U-frame. The soil loading on the walls may be obtained by empirical coefficients, active or passive wedge analyses with corrections for at-rest conditions, or inputing force-deformation curves for the walls. Hydraulic loads are automatically computed from water elevations and drain data. Foundation reaction pressures may be computed using a simple equilibrium approach

or a Winkler spring on elastic foundation model. Design may be by allowable stress or strength design procedures, using American Concrete Institute or Corps criteria. Output includes member pressures, shears, moments, and stress or strength results at discrete points. Graphical output is available. GRA

N90-29935# Illinois Univ., Urbana. Knowledge-Based Systems Group.
KNOWLEDGE BASE REFINEMENT AS IMPROVING AN INCORRECT AND INCOMPLETE DOMAIN THEORY Technical Report, 1 Dec. 1987 - 30 Jan. 1991
David C. Wilkins Apr. 1990 34 p Submitted for publication
(Contracts N00014-79-C-0302; N00014-88-K-0124; NSF MCS-83-12148)
(AD-A224441; UIUCDCS-R-90-1585; UILU-ENG-90-1724) Avail: NTIS HC A03/MF A01 CSCL 12/5

The ODYSSEUS program automates knowledge base refinement by improving a domain theory. The techniques used by ODYSSEUS to address three types of domain theory pathologies are described: incorrectness, inconsistency, and incompleteness. In ODYSSEUS, an incomplete domain theory is extended by the Metarule Chain Completion Method. This method exploits the use of an explicit meta-level representation of the strategy knowledge for a generic problem class (e.g., heuristic classification) that is separate from the domain theory (e.g., medicine) to be improved. The work implements and compares the extension of an incompleted domain theory using case-based inductive learning and explanation-based apprenticeship learning; in the latter, learning occurs by completing failed explanations of observed human problem solving actions. Extending an incomplete domain theory and correcting an incorrect domain theory both use the Confirmation Decision Procedure Method, which validates arbitrary instantiated tuples of the knowledge base by the use of an underlying domain theory. Lastly, the consistency of the knowledge base is improved by use of the Sociopathic Reduction Algorithm. GRA

N90-29936# Oklahoma State Univ., Stillwater.
THE EFFECT OF SOFTWARE REUSABILITY ON INFORMATION THEORY BASED SOFTWARE METRICS M.S. Thesis
William R. Torres 1990 252 p Sponsored by AFIT, Wright-Patterson AFB, OH
(AD-A224472; AFIT/CI/CIA-90-61) Avail: NTIS HC A12/MF A02 CSCL 12/5

The main purpose of this thesis is to theoretically investigate the effect of reusing software on metrics that are based on the entropy function of communication information theory. R. Chanon's Entropy Loading and E. Chen's Control Structure Entropy were applied to C and Ada programs obtained from the open literature. Four units of program decomposition (statement, component, module, and program) along Chanon's definition of an object were introduced to classify software reuse units. A total of three versions for each of the programs included in the study were considered (i.e., optimum reuse, intermediate reuse, and no reuse). The lines of code metric was utilized to quantify the amount of nonreusable code in each of the versions of the programs. The lines of code metric was not applied to the reused segments of code since they are not considered part of the effort of writing the new program. Pearson product-moment correlations were computed between the metrics studied and the lines of code metric. GRA

N90-29937# Federal Aviation Administration, Atlantic City, NJ.
COMMUNICATIONS INTERFACE DRIVER (CID) SOFTWARE PRINCIPLES OF OPERATION
Thomas Bratton, Charles Dudas, Jeffrey Livings, and Mark Schoenthal Sep. 1990 138 p
(DOT/FAA/CT-TN89/46) Avail: NTIS HC A07/MF A01

The Communications Interface Driver (CID) makes possible the performance assessment of the Mode Select (Mode S) sensor under its specified maximum communication load. To accomplish this, CID uses prepared communication scenarios structured on air traffic models to generate the simulated communication messages for Mode S. The physical connection to the Mode S sensor is through X.25 Link Access Procedure Balanced (LAPB) communication lines. This document, the CID Software Principles of Operation, describes the CID software and theory of operations. Each software module is discussed. Data flow diagrams, program flow charts, and timing charts are included where appropriate. Author

N90-29938# Mitre Corp., Bedford, MA.
EFFECTS OF PARAMETER UNCERTAINTIES ON SOFTWARE DEVELOPMENT EFFORT ESTIMATES Final Report
Frederick D. Powell May 1990 58 p
(Contract F19628-86-C-0001)
(AD-A223304; MTR-10226; ESD-TR-90-307) Avail: NTIS HC A04/MF A01 CSCL 12/5

The Constructive Cost Model (COCOMO) for software cost estimation uses inputs of size in lines of code and 15 Development Effort Multipliers (DEMs) that calibrate the estimate to the environment. This study examines the effects of uncertainties, expressed as probability densities of size and DEMs, on COCOMO effort estimates for software developments consisting of more than one Computer Software Configuration Item (CSCI). A Taylor series is used to find the mean and standard deviation of effort in terms of the means and standard deviations of the sizes and the DEMs of the CSCIs. The Central Limit Theorem then enables the evaluation of probability density and cumulative distribution functions for effort. Conditions under which this method is valid are demonstrated. GRA

N90-29939*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE DEVELOPMENT AND EVALUATION OF NUMERICAL ALGORITHMS FOR MIMD COMPUTERS Final Report, 1 Feb. 1988 - 31 Jan. 1990
Robert G. Voigt 31 Jan. 1990 12 p
(Grant AF-AFOSR-0117-88; AF Proj. 2304)
(NASA-TM-101167; NAS 1.15:101167; AD-A223476; AFOSR-90-0663TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

Two activities were pursued under this grant. The first was a visitor program to conduct research on numerical algorithms for MIMD computers. The program is summarized in the following attachments. Attachment A - List of Researchers Supported; Attachment B - List of Reports Completed; and Attachment C - Reports. The second activity was a workshop on the Control of fluid Dynamic Systems held on March 28 to 29, 1989. The workshop is summarized in attachments. Attachment D - Workshop Summary; and Attachment E - List of Workshop Participants. GRA

N90-29940# California Univ., Los Angeles. Inst. for Robotics and Intelligent Systems.
PARALLEL ARCHITECTURES AND ALGORITHMS FOR IMAGE UNDERSTANDING Final Technical Report, 1 Nov. 1988 - 30 Sep. 1989
R. Nevatia and V. K. Prasanna-Kumar 17 May 1990 45 p
LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(Grant AF-AFOSR-0032-89; AF Proj. 2304)
(AD-A223479; AFOSR-90-0675TR) Avail: NTIS HC A03/MF A01 CSCL 12/9

Several issues in using parallel processing for image understanding are addressed. First, efficient schemes for parallel image array access are developed. New class of latin squares called perfect latin squares are defined. Several construction methods are shown and some useful properties of such squares are identified. A generic parallel model of computation employing electro optical devices is developed. Parallel techniques for image computations are developed on this model. Finally, processor time optimal solutions to several low and intermediate level image understanding tasks are designed on orthogonal access parallel architectures. GRA

N90-29941# Naval Ocean Research and Development Activity, Bay Saint Louis, MS. Ocean Sensing and Prediction Div.
A GLOBAL APPROACH TO IMAGE TEXTURE ANALYSIS Ph.D. Thesis - South Carolina Univ. Final Report
R. J. Holyer Mar. 1990 271 p Sponsored in part by Office of Naval Technology
(AD-A223532; NORDA-238) Avail: NTIS HC A12/MF A02 CSCL 12/9

This new approach is based on linear unmixing of texture measures calculated over an entire image (called a global approach), as opposed to most present texture analysis techniques that compute texture over small neighborhoods (called a local approach). The new global paradigm is appropriate for images where spatial scales of the texture variability are large with respect to the pixel spacing, thereby making the local approach ineffective. Airborne passive microwave imagery of Arctic sea ice contain textures that vary with ice-type. These ice textures are of the type best treated by the global approach. Sea-ice imagery is used as test data to evaluate the global techniques that are developed. Pure, single ice-type images; synthetic mixtures formed by mosaicking pure ice-type subimages in known proportions; and naturally occurring mixture images are analyzed. Proportions of first-year, second-year, and multiyear ice within mixture images are retrieved with root-mean-square accuracies as low as 0.04 by the new method. While this accuracy is adequate to be useful in many Arctic studies, the global technique seems promising for many other remote sensing and general image processing applications. GRA

N90-29942# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ. Fire Support Armament Center.
COMPUTER-AIDED ENGINEERING ENVIRONMENT FOR CONTROLLED MECHANICAL SYSTEMS Final Report, Sep. 1988 - Sep. 1989
Michael Mattice, Steven Banks, Pradip N. Sheth, and Kevin C. Craig (Rensselaer Polytechnic Inst., Troy, NY.) Jun. 1990 31 p
(AD-A223551; ARFSD-TR-90004) Avail: NTIS HC A03/MF A01 CSCL 12/5

A computer-aided engineering environment for the design and analysis of computer controlled mechanical systems is defined, and a prototype environment is demonstrated. The overall integrated environment includes systems for 3D geometric modeling and animation, multibody system dynamics, finite element analysis, and control system design. The integration of a multibody system dynamics program IMP with the control system design program MATRIXx is demonstrated. Transfer functions from the multibody system model, together with mathematical models of any electrical, pneumatic, and hydraulic components, are used in MATRIXx for control system synthesis. The controller architecture and parameters are specified in block diagram form and converted to real-time program through an automatic code generator in MATRIXx. This program is downloaded to microprocessor for controlling the actual, physical plant. In the computer-aided engineering environment of this report, the controller program with any nonmechanical component models included is combined with the original IMP nonlinear mechanical system model. The dynamic response of this complete system is studied to verify the controller design for this nonlinear, more realistic mechanical model. GRA

N90-29943# Odyssey Research Associates, Inc., Ithaca, NY.
FORMAL VERIFICATION OF MATHEMATICAL SOFTWARE, VOLUME 2 Final Technical Report, May 1986 - Jul. 1989
Stephen H. Brackin and Ian Sutherland May 1990 224 p
(Contract F30602-86-C-0116)
(AD-A223633; RADC-TR-90-53-Vol-2) Avail: NTIS HC A10/MF A02 CSCL 12/5

One of the major problems encountered in trying to formally verify the correctness of computer programs that use real arithmetic (hereafter referred to as mathematical programs) is that the mathematical properties of real arithmetic operations in computers are much more complicated and much harder to work with than the mathematical properties of the corresponding ideal mathematical operations. This occurs because the real number type implemented on a finite computer is not the same as the ideal, mathematical real number type. A finite machine can only represent finitely many different real numbers, whereas there are infinitely many ideal real numbers. The idea behind the theory of asymptotic computing is to develop techniques to prove that the accuracy of a mathematical program goes to infinity (e.g., larger and larger numbers of representation bits for mantissas and exponents used in binary floating point arithmetic). The theory of asymptotic computing, then, is essentially a general formalization of the notions of accuracy and accuracy going to infinity, but without having to show how fast convergence happens (a major source of difficulty in numerical analysis). GRA

N90-29944# Princeton Univ., NJ. Dept. of Computer Science.
SHORT ENCODINGS OF EVOLVING STRUCTURES
Daniel D. Sleator (Carnegie-Mellon Univ., Pittsburgh, PA.), Robert E. Tarjan, and William P. Thurston Apr. 1990 27 p Sponsored in part by DARPA
(Contracts N00039-87-C-0251; N00014-87-K-0467; NSF CCR-86-58139; NSF STC-88-09648; NSF DCR-86-05962; NSF DMS-88-06067)
(AD-A223641; CS-TR-265-90) Avail: NTIS HC A03/MF A01 CSCL 12/1

A derivation in a transformational system such as a graph grammar may be redundant in the sense that the exact order of the transformations may not affect the final outcome; all that matters is that each transformation, when applied, is applied to the correct structure. By taking advantage of this redundancy, an efficient encoding scheme was developed for such derivations. This encoding scheme has a number of diverse applications. It can be used in efficient enumeration of combinatorial objects or for compact representation of program and data structure transformations. It can also be used to derive lower bounds on lengths of derivations. It is shown that omega (n log n) applications of the associative and commutative laws are required in the worst case to transform an n-variable expression over a binary associative and commutative laws are required in the worst case to transform an n-variable expression over a binary associative, commutative operation into some other equivalent expression. Similarly, it is shown that omega (n log n) diagonal flips are required in the worst case to transform on n-vertex numbered triangulated planar graph into some other one. Both of these lower bounds have matching upper bounds. An O(n log n) upper bound for associative, commutative operations was known previously, whereas an O(n log n) upper bound for diagonal flips is obtained. GRA

N90-29945# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
A COMPARISON OF HARDWARE IMPLEMENTATIONS FOR LOW-LEVEL VISION ALGORITHMS Memorandum Report
Ed Gamble Nov. 1989 52 p
(Contracts N00014-85-K-0124; DACA76-85-C-0010)
(AD-A223699; AI-M-1173) Avail: NTIS HC A04/MF A01 CSCL 12/6

Early and intermediate vision algorithms, such as smoothing and discontinuity detection, are often implemented on general-purpose serial, and, more recently, parallel computers. The excessive time required by these general-purpose computers prevents real-time computation of these vision algorithms. Special-purpose hardware implementations of low-level vision algorithms may be needed to achieve real-time processing. This memo reviews and analyzes some hardware implementations of low-level vision algorithms. Two types of hardware implementations are considered: the digital signal processing chips of Ruetz (and Broderson) and the analog VLSI circuits of Carver Mead. Both these approaches claim to achieve real-time image processing; both have limited the vision problem that they solved in ways largely inconsistent with vision processing in unrestricted environments. The advantages and disadvantages of these two approaches for producing a general, real-time vision system are considered. As early attempts at comprehensive vision hardware,

these two approaches provide useful insights for future developments of vision hardware. GRA

N90-29946# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
MACHINE RECOGNITION AS REPRESENTATION AND SEARCH Memorandum Report
Feng Zhao Dec. 1989 42 p Revised
(Contract N00014-89-J-3202)
(AD-A223700; AI-M-1189) Avail: NTIS HC A03/MF A01 CSCL 12/9

Generality, representation, and control have been the central issues in machine recognition. Model-based recognition is the search for consistent matches of the model and image features. A comparative framework is presented for the evaluation of different approaches, particularly those of ACRONYM, RAF, and Ikeuchi et al. The strengths and weaknesses of these approaches are discussed and compared and remedies are suggested. Various tradeoffs made in the implementations are analyzed with respect to the systems' intended task-domains. The requirements for a versatile recognition system are motivated. Several directions for future research are pointed out. GRA

N90-29947# Yale Univ., New Haven, CT. Dept. of Computer Science.
FAST ALGORITHMS FOR PARALLEL ARCHITECTURES Final Report, 1 Jul. 1986 - 30 Sep. 1989
Martin H. Schultz 12 Mar. 1990 4 p
(Contract DAAL03-86-G-0029)
(AD-A223731; ARO-23777.1-MA-F) Avail: NTIS HC A01/MF A01 CSCL 12/6

Our work on Fast Algorithms for Parallel Architectures led us to investigate methods for computing all eigenvalues and eigen vectors of a summetric tridiagonal matrix on a distributed-memory MIMD multiprocessor. We have studied only those techniques having the potential for both high accuracy and significant large-grained parallelism. These include the QL method or Cuppen's divide and conquer method based on rank-one updating to compute both eigenvalues and eigen vectors, bisection to determine eigenvalues, and inverse iteration to compute eigen vectors. GRA

N90-29948# Naval Postgraduate School, Monterey, CA. Dept. of Computer Science.
GRAPHIC INTERFACE FOR ATTRIBUTE-BASED DATA LANGUAGE QUERIES FROM A PERSONAL COMPUTER TO THE MULTI-LINGUAL, MULTI-MODEL, MULTI-BACKEND DATABASE SYSTEM OVER AN ETHERNET NETWORK M.S. Thesis
William Goebel Sympson, III Dec. 1989 128 p
(AD-A223738) Avail: NTIS HC A07/MF A01 CSCL 12/5

This research is aimed at taking us one step closer to the goal of the paperless ship. This thesis examined the feasibility of providing a visual interface to allow queries from a front end Personal Computer (PC) using the Attribute-Based Data Language (ABDL) to a Multi-Lingual, Multi-Model, Multi-Backend mini-computer. Providing an improved Human-Machine Interface for the system will greatly increase its usability. A prototype was implemented in the Graphics Language for Database (GLAD) on a Zenith 248 as the front end connected to a ISI mini-computer running the Multi-Lingual, Multi-Model, Multi-Backend Database System (MBDS), a backend of the future. The Zenith 248 was chosen as the front end because of the large quantity of these computers throughout the Navy. GLAD was used because it is a graphics object-oriented environment for databases that gives the user access to both data manipulation and program development through visual interaction. This creates a user friendly windowing environment both for development and for operational applications. Looking towards the future, MBDS is the perfect backend as it is the latest in database management systems. This thesis provided an extension to GLAD to demonstrate the ability to send Attribute-Based Data Language to Multi-Backend Database System. GRA

N90-29949# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
LANGUAGE AND SYSTEM SUPPORT FOR CONCURRENT PROGRAMMING Final Report
Michael B. Feldman (George Washington Univ., Washington, DC.) Apr. 1990 47 p
(Contract F19628-89-C-0003)
(AD-A223760; CMU/SEI-CM-25) Avail: NTIS HC A03/MF A01 CSCL 12/5

This curriculum module is concerned with support for concurrent programming provided to the application programmer by operating systems and programming languages. This includes system calls and language constructs for process creation, termination, synchronization, and communication, as well as nondeterministic language constructs such as the selective wait and timed call. Several readily available languages are discussed and compared: concurrent programming using system services of the UNIX operating system is introduced for the sake of comparison and contrast. GRA

N90-29950# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
DURRA: A TASK-LEVEL DESCRIPTION LANGUAGE USER'S MANUAL Final Report
Mario R. Barbacci, Dennis L. Doubleday, and Charles B. Weinstock Sep. 1989 34 p
(Contract F19628-85-C-0003)
(AD-A223761; CMU/SEI-89-TR-33; ESD-TR-89-44) Avail: NTIS HC A03/MF A01 CSCL 12/5

Durra is a language designed to support the development of large-grained parallel programming applications. This is the manual for users of the Durra compiler, runtime system, and support tools. Additional documents that describe the syntax and semantics of the language and the runtime environment are cited in the bibliography section. GRA

N90-29951# Naval Postgraduate School, Monterey, CA. Dept. of Electrical and Computer Engineering.
MACROOTLOCUS: A CAD DESIGN TOOL FOR FEEDBACK CONTROL SYSTEMS M.S. Thesis
Sung Hoon Ko Dec. 1989 190 p
(AD-A223772) Avail: NTIS HC A09/MF A01 CSCL 12/5

MacRootLocus, a computer-aided design program, was developed as an analysis and design tool for linear feedback control systems. A variety of programs are presently available for the IBM-PC and IB mainframe. The Apple Macintosh offers just a one-parameter root locus method capability. MacRootLocus supports both one-and two-parameter root locus methods on the Apple Macintosh. It is written in the computer language Turbo Pascal which is the native language of the Apple Macintosh and is designed with the same user friendliness and standard interface philosophy the Macintosh was designed for. GRA

N90-29952# Wright Research Development Center, Wright-Patterson AFB, OH. Avionics Logistics Branch.
SOFTWARE DEVELOPMENT: A PRODUCT LIFE-CYCLE PERSPECTIVE Summary Report, Aug. 1989 - Feb. 1990
James W. McCord May 1990 58 p
(AF Proj. 2003)
(AD-A223783; WRDC-TR-90-1063) Avail: NTIS HC A04/MF A01 CSCL 12/5

This paper describes the complete cycle of the development of a software product in the commercial software industry. This development cycle includes three major categories. These categories are pre-development, development, and post-development activities. By carefully studying the commercial development cycle, deficiencies in the way the Air Force and the DOD develop software can be identified. Although several of the ideas described in this process do not directly relate to development in a non-commercial world, most do relate in some form or fashion. Although marketing, in the true sense, is not done in a non-commercial world, it is necessary to sell, thus market, project ideas. Throughout this paper, the terms customer and market are

used. For the purposes of interpreting the usefulness of this process to non-commercial development, these terms can best be thought of as the users of the software product (major commands, logistics centers, etc). By carefully examining the current software development process as done by the DOD and the Air Force (DOD-STD-2167A), and comparing it to the equivalent commercial development process, it is possible to better understand why DOD-STD-2167A is structured at system-level development and to objectively evaluate the merits of the current development process (DOD-STD-2167A). GRA

N90-29953# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
MUSE: A SYSTOLIC ARRAY FOR ADAPTIVE NULLING WITH 64 DEGREES OF FREEDOM, USING GIVENS TRANSFORMATIONS AND WAFER SCALE INTEGRATION
C. M. Rader, D. L. Allen, D. B. Glasco, and C. E. Woodward 18 May 1990 82 p
(Contract F19628-90-C-0002)
(AD-A223812; TR-886; ESD-TR-90-0191) Avail: NTIS HC A05/MF A01 CSCL 12/6

This report describes an architecture for a highly parallel system of computational processors specialized for real-time adaptive antenna nulling computations with many degrees of freedom, which we call MUSE (Matrix Update Systolic Experiment), and a specific realization of MUSE for 64 degrees of freedom. Each processor uses the CORDIC algorithm and has been designed as a single integrated circuit. Ninety-six such processors working together can update the 64-element nulling weights based on 300 new observations in only 6.7 milliseconds. This is equivalent to 2.88 Giga-ops for a conventional processor. The computations are accurate enough to support 50 decibel of signal-to-noise improvement in a sidelobe canceller. The connectivity between processors is quite simple and permits MUSE to be realized on a single large wafer, using restructurable VLSI (Very Large Scale Integration). The complete design of such a wafer is described. GRA

N90-29954# APTEK, Inc., Colorado Springs, CO.
AN INTERACTIVE OPTIMIZATION BASED, COMPUTER GRAPHICS SOFTWARE PACKAGE. PHASE 2: USERS MANUAL Final Technical Report, Oct. 1987 - Oct. 1989
Mark D. Landon and Jerry L. Udy 25 Oct. 1989 150 p
(Contract F08635-88-C-0063)
(AD-A223854; MSD-TR-90-10) Avail: NTIS HC A07/MF A01 CSCL 12/5

This report documents the work that was completed to develop the software tools and geometric data base that will help Air Force Design Engineers take aircraft and missiles from concept to test specimen. Navgraph is a geometric modeling program that allows the user to define complex, convex and non-convex geometric solid objects for use in the various modules developed. A summary of the capabilities are given here: NAVGRAPH can be used to create geometric models of aircraft, weapons, submunitions, pylons, racks, etc. to whatever detail is necessary for the problem being studied. NAVGRAPH can be used to recall any geometric model(s) from the existing data base (via DBMERGE) to define the desired complex model to whatever detail is necessary. The existing data base consists of the models developed under this contract, mainly, an F-15 aircraft, fuel tank, racks, rails, bombs, missiles, and submunitions. CALIPER can be used to study physical fit compatibility. For example, CALIPER can calculate the separation distance between a missile fin and an aircraft wing or detect and calculate the interference distance and direction of internal components with respect to the interior of a missile body. The information derived here can be used to translate the interfering object and remove the interference. GRA

N90-29955# Sandia National Labs., Albuquerque, NM. Applied Mechanics Div.
RAY TRACED SCALAR FIELDS WITH SHADED POLYGONAL OUTPUT
Ray J. Meyers and Michael B. Stephenson 1990 14 p Presented at the Visualization 1990, San Francisco, CA, 23-26 Oct. 1990 Sponsored in part by Advanced Fuel Research, Inc.; Detroit Diesel Allison; Babcock and Wilcox; Chevron Research Co.; Combustion Engineering, Inc.; Consolidation Coal Co.; Convex Computer Corp.; Corning Glass Works; Dow Chemical; EPRI; Empire State El
(Contract DE-AC04-76DP-00789; NSF CDR-85-22618)
(DE90-011023; SAND-90-1383C; CONF-901089-1) Avail: NTIS HC A03/MF A01

An algorithm is presented on rendering scalar field data which reduces rendering times by as much as two orders of magnitude over traditional full resolution image. Less than full resolution sampling of the scalar field is performed using a fast ray tracing method. The sampling grid points are output as a set of screen based gouraud shaded polygons which are rendered in hardware by a graphics workstation. A gradient based variable resolution algorithm is presented which further improves rendering speed. Several examples are presented. DOE

N90-29956# Los Alamos National Lab., NM.
GSHELL: MULTICHANNEL ANALYZER/MULTICHANNEL SCALER EMULATION SOFTWARE FOR IBM-PC-COMPATIBLE COMPUTERS
Robert J. Estep Aug. 1990 53 p
(Contract W-7405-eng-36)
(DE90-015396; LA-11908-MS) Avail: NTIS HC A04/MF A01

We have developed a multichannel analyzer/multichannel scaler program for use on IBM-PC-compatible computers. This software, called GSHELL, offers several advantages over commercial emulation software. The principle advantages are the availability of fully documented source codes, compatibility with (potentially) all brands of hardware, advanced looping capabilities in ASCII command files, and access to global variables and spectra in user-written software. DOE

N90-29957# Lawrence Livermore National Lab., CA.
BISPECTRAL-BASED OPTIMIZATION ALGORITHMS FOR SPECKLE IMAGING
Dennis M. Goodman, Taylor W. Lawrence, J. Patrick Fitch, and Erik M. Johansson 1990 15 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract W-7405-eng-48)
(DE90-015610; UCRL-JC-104478; CONF-900756-25) Avail: NTIS HC A03/MF A01

We present results of a horizontal path imaging experiment using a 0.5-m telescope focused on a target 1.2 km away. We consider an extended representation of a satellite with grey scale and size variations. We imaged at 0.7 microns and found an average atmospheric degradation factor of D/r(sub 0) = 17. We used a slow read-rate, bare CCD detector; thus, we had to deal with additive measurement noise. Our image reconstruction algorithms are based on the complex bispectrum, and we have demonstrated diffraction-limited imaging down to light levels approaching a few photons per speckle per resolution area. We have paid careful attention to the effects of additive noise on the reconstruction process and have shown that they can be adequately overcome. We present some new algorithms based on conjugate gradients and least squares. We demonstrate that these algorithms can improve image quality. DOE

N90-29958# Los Alamos National Lab., NM.
A MANUAL FOR MICROCOMPUTER IMAGE ANALYSIS
Paul M. Rich (Stanford Univ., CA.), Douglas M. Ranken, and John S. George Dec. 1989 76 p
(Contract W-7405-eng-36)
(DE90-015629; LA-11732-M) Avail: NTIS HC A05/MF A01

This manual is intended to serve three basic purposes: as a primer in microcomputer image analysis theory and techniques, as a guide to the use of IMAGE(copyright), a public domain microcomputer program for image analysis, and as a stimulus to encourage programmers to develop microcomputer software suited for scientific use. Topics discussed include the principals of image

processing and analysis, use of standard video for input and display, spatial measurement techniques, and the future of microcomputer image analysis. A complete reference guide that lists the commands for IMAGE is provided. IMAGE includes capabilities for digitization, input and output of images, hardware display lookup table control, editing, edge detection, histogram calculation, measurement along lines and curves, measurement of areas, examination of intensity values, output of analytical results, conversion between raster and vector formats, and region movement and rescaling. The control structure of IMAGE emphasizes efficiency, precision of measurement, and scientific utility. DOE

N90-29959# Cornell Univ., Ithaca, NY.
PARALLEL AND SPARSE METHODS FOR LARGE-SCALE NUMERICAL OPTIMIZATION Progress Report
Thomas F. Coleman and Stephen A. Vavasis 29 May 1990 5 p
(Contract DE-FG02-86ER-25013)
(DE90-015655; DOE/ER-25013/5) Avail: NTIS HC A01/MF A01

Progress is reported in parallel and sparse methods for large scale numerical optimization of linear programming problems. DOE

N90-29960# Oak Ridge National Lab., TN. Engineering Physics and Mathematics Div.
DEVELOPING TOOLS FOR PERFORMANCE VISUALIZATION OF PARALLEL ALGORITHMS
M. T. Heath 10 Aug. 1990 7 p Presented at the 1990 IBM Europe Inst., Oberlech, Austria, 30 Jul. - 3 Aug. 1990
(Contract DE-AC05-84OR-21400)
(DE90-015801; ORNL/FTR-3700) Avail: NTIS HC A02/MF A01

The traveler attended the 1990 IBM Europe Institute in Oberlech, Austria. The conference featured many presentations and other activities of interest to the Office of Naval Research, London (ONRL) research programs in parallel computing, particularly in the area of parallel software support tools. The traveler presented a talk on his work at ORNL in developing tools for performance visualization of parallel algorithms. The traveler held numerous technical discussions on issues having direct relevance to ORNL research programs. DOE

N90-29961# Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
A PARALLEL LEAST SQUARES COLLOCATION CONJUGATE GRADIENT APPROACH FOR THE ADVECTION DIFFUSION EQUATION
Alexander Peters and George F. Pinder 1989 31 p Presented at the 6th Conference on Computing in Civil Engineering, Atlanta, GA, 11-13 Sep. 1989 Sponsored in part by NATO
(Contract DE-FG02-86ER-60453)
(DE90-015965; CONF-890993-2) Avail: NTIS HC A03/MF A01

This paper presents an accurate and very robust least squares collocation technique that allows one to employ the preconditioned conjugate gradient solution procedure and orthogonal meshes to the solution of the advection diffusion equation defined over domains with irregular shape. The new approach can achieve a reasonable fraction of the optimal performance of a wide variety of parallel architectures since most of its computational tasks are performed independently. DOE

N90-29962# Washington Univ., Seattle.
COMPUTING ENVIRONMENTS, INTERACTIVE GRAPHICS AND NONPARAMETRIC METHODS FOR DATA ANALYSIS Progress Report, 1988-1989
1990 16 p
(Contract DE-FG06-85ER-25006)
(DE90-016127; DOE/ER-25006/4) Avail: NTIS HC A03/MF A01

Computing environments, interactive graphics and nonparametric methods for data analysis are discussed. DOE

N90-29963# Oak Ridge Gaseous Diffusion Plant, TN. Computing and Telecommunications Div.
AUTOMATED CADAM DATA TRANSFER: USER'S MANUAL
D. A. Holder and R. K. Schwarz Jul. 1990 24 p
(Contract DE-AC05-84OT-21400)
(DE90-014871; K/CSD/TM-94) Avail: NTIS HC A03/MF A01

This manual describes the Automated Data Transfer program developed at Martin Marietta Energy Systems, Inc., to provide an enhanced method for transferring CADAM drawings in both directions between MICRO CADAM on the personal computer (PC) and CADAM on the mainframe. Section 2.0 of this manual presents an overview of the Automated CADAM Data Transfer program, describing the program's purpose; the data that it handles; the functions it performs; the hardware, software, and access requirements; and help and error functions. Section 3.0 describes the interactive menu-driven operation of the automated CADAM Data Transfer program. DOE

N90-29964# Washington Univ., Seattle.
COMPUTING ENVIRONMENTS, INTERACTIVE GRAPHICS AND NONPARAMETRIC METHODS FOR DATA ANALYSIS
1990 19 p Presented at the ASA Annual Meeting, WA, Aug. 1989 and at the AT and T Statistics Group, NJ, Oct. 1989
(Contract DE-FG06-85ER-25006)
(DE90-016128; DOE/ER-25006/5) Avail: NTIS HC A03/MF A01

This report discusses progress for the year 1989 to 1990 in computing environments, interactive graphics and nonparametric methods for data analysis. DOE

N90-29965*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FORMAL DESIGN AND VERIFICATION OF A RELIABLE COMPUTING PLATFORM FOR REAL-TIME CONTROL. PHASE 1: RESULTS
Ben L. DiVito (Vigyan Research Associates, Inc., Hampton, VA.), Ricky W. Butler, and James L. Caldwell Oct. 1990 69 p
(NASA-TM-102716; NAS 1.15:102716) Avail: NTIS HC A04/MF A01 CSCL 09B

A high-level design is presented for a reliable computing platform for real-time control applications. Design tradeoffs and analyses related to the development of the fault-tolerant computing platform are discussed. The architecture is formalized and shown to satisfy a key correctness property. The reliable computing platform uses replicated processors and majority voting to achieve fault tolerance. Under the assumption of a majority of processors working in each frame, it is shown that the replicated system computes the same results as a single processor system not subject to failures. Sufficient conditions are obtained to establish that the replicated system recovers from transient faults within a bounded amount of time. Three different voting schemes are examined and proved to satisfy the bounded recovery time conditions. Author

N90-29966# Loughborough Univ. of Technology (England). Dept. of Electrical and Electronic Engineering.
SOFTWARE DESIGN FOR HIGH INTEGRITY SYSTEMS M.S. Thesis
Raymond Vicino 1989 108 p
(ETN-90-97517) Avail: NTIS HC A06/MF A01

The current design for safety critical systems is reviewed and methods divided into two categories: fault avoidance and fault tolerance. The concept and objectives of formal methods are examined. To demonstrate the diversity in formal specification methodologies and languages, the Vienna Development Method (VDM), Z, High Order Logic (HOL), Gypsy, and OBJ are reviewed. Mathematical concepts behind formal specification languages are discussed. To demonstrate the use of formal methods, the application of the VDM to the specification of two sample control problems is considered. Arguments for and against the use of formal methods for software specification are discussed. ESA

N90-29967# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Automatisierung.
ESTIMATION AND REPRESENTATION OF MULTIDIMENSIONAL MAPPINGS
Friedrich Lange 1990 145 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-IT-1223)
(DLR-Mitt-90-06; ISSN-0176-7739; ETN-90-97540) Avail: NTIS HC A07/MF A01; DLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Rep. of Germany, HC 51.50 deutsche marks

A software tool to determine nonlinear functions of continuous input variables using some possibly disturbed functional values at stochastic places is presented. It is possible to update the estimation at every time without restricting the availability of the estimates in the meantime. The ability of iterative choice and training by using optimal filtering makes the method suitable for tasks which in the past needed associative memories, and provides a good alternative to approximation methods. Locally valid parametric representations are possible by providing a parameter vector. The method can be used for varied tasks, such as recording or storing of characteristic lines or generation of learning controllers. ESA

N90-29968# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Mathematics and Software Div.
ESTEC SOFTWARE CATALOGUE
S. Battrick, comp. Jun. 1990 147 p
(ESA-SP-1133; ISBN-92-9092-108-0; ISSN-0379-6566; ETN-90-97590) Copyright Avail: NTIS HC A07/MF A01; EPD, ESTEC, Noordwijk, The Netherlands, HC 40 Dutch guilders

The underlying goal was to take stock of the wide spectrum of software tools already available and thereby identify those additional software tools that will be needed to support the new programs being planned for the coming years. Many of the software tools listed are unique and were specially developed in support of the current European space program; others were bought in commercially for exploitation in their original or adapted form. Wherever possible, the degree of originality of the software is given with each entry. The following are covered: applications software, personal computer and workstation software software, database management systems and the ESTEC (European Space Research and Technology Centre) software. ESA

N90-29969# European Space Agency, Paris (France).
HANDBOOK OF DATA COMPRESSION ALGORITHMS
F. L. G. Kordes, R. A. Hogendoorn, J.-L. Marchand, and R. Sliwa, ed. 1990 100 p
(ESA-TM-06; ISBN-92-9092-013-0; ISSN-1013-7076; ETN-90-97593) Copyright Avail: NTIS HC A05/MF A01

A handbook intended to help data compression users with the selection of a suitable algorithm is presented. An overview of algorithms for a wide range of applications is provided. Algorithms for non-image data, many algorithms for images and even algorithms for image sequences, are contained. For each algorithm, a general description and a more detailed description that should be efficient for the actual implementation of the algorithm, are given. The complexity of each algorithm in terms of execution time and storage requirements is given. Performance results as far as they were obtained in studies carried out, are given. ESA

N90-29970 Cranfield Inst. of Tech., Bedford (England). Dept. of Electronic System Design.
AN ADA-BASED MARINE RADAR SIMULATOR FOR COLLISION AVOIDANCE TRAINING M.S. Thesis
W. J. E. Wells Sep. 1989 150 p
(ETN-90-97611) Copyright Avail: Cranfield Institute of Technology, Cranfield, Bedfordshire MK43 0AL, England

The specification, software design and implementation of a small-ship radar simulator running on an IBM personal computer for subsequent use in the training of ships navigators (or pilots) in collision avoidance procedures, are detailed. The use of the program language Ada is explained. Two other previously unencountered large topic areas: two-dimensional computer graphics, and basic radar and associated displays as used in ship-board navigation and collision avoidance were investigated. ESA

N90-29971 National Physical Lab., Teddington (England). Div. of Electrical Science.
ANALYTIC LEAST SQUARES
R. E. Borland May 1990 10 p
(NPL-DES-86; ISSN-0143-7305; ETN-90-97615) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

In some measurement processes the quantity of interest is determined by a least squares process. In order to study the optimum way to perform these measurements to obtain the lowest uncertainty, it is desirable to formulate an analytic model of the measurement process. How the least square process can be performed on an analytic model, rather than on a particular set of measured values, to yield the contributions to the uncertainty, is described. The application stimulating the study was that in antenna metrology. ESA

N90-29972 Politecnico di Milano (Italy). Dipt. di Elettronica.
DIRECTING AN ANIMATED SCENE WITH AUTONOMOUS ACTORS
R. Maiocchi and B. Pernici 1989 30 p
(Rept-89-041; ETN-90-97620) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

PINOCCHIO, a motion control system for computer animation designed for the use by animators in controlling the motion of a puppet is presented. The main goal in PINOCCHIO is to provide digital description of human movements for replication of real movements as closely as possible. Movement is represented through visual simulation using ELITE, a three-dimensional vision system based on a two level architecture reflecting the hierarchical structure of vision in living beings. A general movement dictionary was developed to classify movements and movement attributes using entries from natural language, and each movement in the dictionary was stored in a motion database where it is available for display. Two of the main features of PINOCCHIO, the movement database and an object oriented mechanism for interpolating between sequences of motions specified by animators in a script, are discussed. ESA

N90-29973 Politecnico di Milano (Italy). Dipt. di Elettronica
FORMAL SEMANTICS OF SQL QUERIES
M. Negri (Brescia Univ., Italy), G. Pelagatti, and L. Sbattella 1989 35 p
(Rept-89-069; ETN-90-97621) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The semantics of SQL queries is formally defined by stating of rules which determine a syntax driven translation of an SQL query to a formal model. The target model, called Extended Three Valued Calculus (E3VPC), is largely based on a set of well known mathematical concepts. The rules which allow the transformation of a general E3VPC expression to a canonical form, which can be manipulated using traditional, 2-valued predicate calculus are also given; in this way problems like equivalence analysis of SQL queries are completely solved. The fact that reasoning about equivalence of SQL queries using 2-valued predicate calculus without taking care of the real SQL semantics can lead to errors is shown and the reasons of this fact are analyzed. ESA

N90-29798*# Boeing Aerospace Co., Seattle, WA.
GUIDANCE ALGORITHMS FOR A FREE-FLYING SPACE ROBOT
A. F. Brindle, H. E. M. Viggh, and J. H. Albert *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 191-200 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29803*# National Research Council of Canada, Ottawa (Ontario).
A FAST 3-D OBJECT RECOGNITION ALGORITHM FOR THE VISION SYSTEM OF A SPECIAL-PURPOSE DEXTEROUS MANIPULATOR
Stephen H. Y. Hung *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 245-254 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29810*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THREAD: A PROGRAMMING ENVIRONMENT FOR INTERACTIVE PLANNING-LEVEL ROBOTICS APPLICATIONS
John J. Beahan, Jr. *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 317-327 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29827*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GRAPHIC OVERLAYS IN HIGH-PRECISION TELEOPERATION: CURRENT AND FUTURE WORK AT JPL
Daniel B. Diner and Steven C. Venema *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 511-520 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29864*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EFFICIENT CONJUGATE GRADIENT ALGORITHMS FOR COMPUTATION OF THE MANIPULATOR FORWARD DYNAMICS
Amir Fijany and Robert E. Scheid *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 329-340 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29877*# FMC Corp., Minneapolis, MN. Advanced Systems Center.
KINEMATICS AND CONTROL ALGORITHM DEVELOPMENT AND SIMULATION FOR A REDUNDANT TWO-ARM ROBOTIC MANIPULATOR SYSTEM
Michael P. Hennessey, Paul C. Huang, and Charles T. Bunnell *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 21-30 (For primary document see N90-29874 24-54)
(Contract DAAA19-87-0094)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29885*# Massachusetts Inst. of Tech., Cambridge.
INTERSET: A NATURAL LANGUAGE INTERFACE FOR TELEOPERATED ROBOTIC ASSEMBLY OF THE EASE SPACE STRUCTURE
Daniel K. Boorsma *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 103-108 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29902*# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
COMPUTER SIMULATION AND DESIGN OF A THREE DEGREE-OF-FREEDOM SHOULDER MODULE
David Marco, L. Torfason, and Delbert Tesar (Texas Univ., Austin.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 273-282 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29904*# Ohio State Univ., Columbus. Dept. of Computer and Information Science.
GENERIC TASK PROBLEM SOLVERS IN SOAR
Todd R. Johnson, Jack W. Smith, Jr., and B. Chandrasekaran *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 295-300 (For primary document see N90-29874 24-54)
(Contract F30602-85-C-0010; HL-38776; AF-AFOSR-0255-82; LM-00083)
Avail: NTIS HC A19/MF A03 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N90-29974# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
ASSEMBLER FOR A PARALLEL COMPUTER [HEIRETSU KEISANKI NO ASENBURA]
Koichi Harada Jun. 1988 18 p In JAPANESE
(NAL-TM-586; ISSN-0452-2982; JTN-90-80119) Avail: NTIS HC A03/MF A01

With the progress of a numerical simulation technique, trends in the development of a super computer may be applied to the development of a parallel computer. However, the performance of the parallel computer particularly depends on the adaptiveness of the application program. In order to evaluate the program's adaptability precisely, the program must be ported to the parallel computer, and the commands traced to make clear the operations of a processor, a register, a memory and so on. For this purpose, the architecture of the simulator which simulates the operation of a parallel computer precisely has been developed. The next step is to reconstitute the application program for the command system of a parallel computer. The direct translation of the program to machine code requires a great deal of effort and errors are easy to make. On the other hand, it is ideal for translating the application program written by a higher level language to the command system of a parallel computer directly. However, in order to do that, it is necessary to develop the compiler for a parallel computer. It is too extensive to verify the usefulness of it. For above mentioned reasons, an assembler which is located between two methods has been planned. This assembler is constructed of a two-path system. Considering the speciality of a parallel computer, this assembler is built with emphasis on functioning as the assembler.
NASDA

N90-29975*# Cornell Univ., Ithaca, NY. ISIS Project.
SUPPORTING LARGE SCALE APPLICATIONS ON NETWORKS OF WORKSTATIONS
Robert Cooper and Kenneth P. Birman 12 Apr. 1989 5 p
(Grant NAG2-593)
(NASA-CR-186346; NAS 1.26:186346) Avail: NTIS HC A01/MF A01 CSCL 09B

Distributed applications on networks of workstations are an increasingly common way to satisfy computing needs. However, existing mechanisms for distributed programming exhibit poor performance and reliability as application size increases. Extension of the ISIS distributed programming system to support large scale distributed applications by providing hierarchical process groups is discussed. Incorporation of hierarchy in the program structure and exploitation of this to limit the communication and storage required in any one component of the distributed system is examined.
Author

N90-29976*# Cornell Univ., Ithaca, NY.
LOW COST MANAGEMENT OF REPLICATED DATA IN FAULT-TOLERANT DISTRIBUTED SYSTEMS
Thomas A. Joseph and Kenneth P. Birman 1990 17 p
(Grant NAG2-593)
(NASA-CR-186370; NAS 1.26:186370) Copyright Avail: NTIS HC A03/MF A01 CSCL 09B

Many distributed systems replicate data for fault tolerance or availability. In such systems, a logical update on a data item results in a physical update on a number of copies. The synchronization and communication required to keep the copies of replicated data consistent introduce a delay when operations are performed. A technique is described that relaxes the usual degree of synchronization, permitting replicated data items to be updated concurrently with other operations, while at the same time ensuring that correctness is not violated. The additional concurrency thus obtained results in better response time when performing operations on replicated data. How this technique performs in conjunction with a roll-back and a roll-forward failure recovery mechanism is also discussed. Author

N90-29977*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
RELIABLE COMMUNICATION IN THE PRESENCE OF FAILURES
Kenneth P. Birman and Thomas A. Joseph 1987 30 p
(Contract NAG2-593; MDA903-85-C-0124; NSF DCR-84-12582; ARPA Order 5378)
(NASA-CR-183046; NAS 1.26:183046) Copyright Avail: NTIS HC A03/MF A01

The design and correctness of a communication facility for a distributed computer system are reported on. The facility provides support for fault-tolerant process groups in the form of a family of reliable multicast protocols that can be used in both local- and wide-area networks. These protocols attain high levels of concurrency, while respecting application-specific delivery ordering constraints, and have varying cost and performance that depend on the degree of ordering desired. In particular, a protocol that enforces causal delivery orderings is introduced and shown to be a valuable alternative to conventional asynchronous communication protocols. The facility also ensures that the processes belonging to a fault-tolerant process group will observe consistant orderings of events affecting the group as a whole, including process failures, recoveries, migration, and dynamic changes to group properties like member rankings. A review of several uses for the protocols is the ISIS system, which supports fault-tolerant resilient objects and bulletin boards, illustrates the significant simplification of higher level algorithms made possible by our approach. Author

N90-29978# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
FAULT TOLERANT DESIGN FOR MULTISTAGE ROUTING NETWORKS
Andre DeHon, Tom Knight, and Henry Minsky Apr. 1990 21 p
(Contracts N00014-88-K-0825; N00014-85-K-0124)
(AD-A224267; AI-M-1225) Avail: NTIS HC A03/MF A01 CSCL 12/7

As the size of digital systems increases, the average length of time between single component failures diminishes. To avoid component related failures, large computers must be fault tolerant; that is, the computer must perform correctly even when some components fail. Fault tolerance is sought in the interconnection network for massively parallel MIMD computers. Particularly, the focus is on methods for achieving a high degree of fault tolerance in multistage routing networks. A multipath scheme is described for providing end-to-end fault tolerance on large networks. The scheme improves routing performance while keeping network latency low. The novel routing component RN1 is described which implements this scheme, showing how it can be the basic building block for fault tolerant multistage routing networks. GRA

N90-29979# Naval Research Lab., Washington, DC. Integrated Warfare Technology Branch.
A HIGH-SPEED KDL-RAM FILE SYSTEM FOR PARALLEL COMPUTERS
C. Severance, T. J. Rosenau, and S. Pramanik (Michigan State Univ., East Lansing.) 22 Jun. 1990 16 p Sponsored in part by NSF
(AD-A223299; NRL-9259) Avail: NTIS HC A03/MF A01 CSCL 12/7

Here we present the design, implementation, and performance of a main memory file system. The implementation is based on a two-stage abstract parallel processing model whose objective is to maximize throughput and minimize response time. To maximize throughput, lock structures, access structures, and shared variables are distributed among the shared memories. A new, hash-based approach for parallel accesses is used. The effect of lock conflicts are minimized by an optimistic locking protocol. Analytical models are developed for hot-spot memory, distributed-data accesses, and space-vs-time trade-offs for fast accesses to records. Based on the performance results of these models, a high-speed KDL-RAM File System has been implemented on the Butterfly PLUS Parallel Processor and its performance results are given. We show that the performance improvement of this system is considerably better than Bolt, Beranek, and Newman, Inc.'s (BBN's) Butterfly RAMFile System on the Butterfly Parallel Processor. GRA

N90-29980# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
INNOVATIVE USES OF PARALLEL COMPUTERS Final Report, 1 Nov. 1988 - 31 Oct. 1989
Gerard Vichniac and Kim Molvig 1 May 1990 4 p
(Grant AF-AFOSR-0119-89; AF Proj. 2304)
(AD-A223578; AFOSR-90-0735TR) Avail: NTIS HC A01/MF A01 CSCL 20/9

One of the significant discoveries that was made was primarily supported by the Office of Naval Research and involves the development and extensive simulations of an original model that demonstrates the viability of the lattice-gas approach to hydrodynamics. The model overcomes major difficulties of the previous discrete approaches. These difficulties can be traced to discretization artifacts that introduce a violation of the Galilean invariance and spurious energy terms in the equation of state. GRA

N90-29981# Stanford Univ., CA.
ASYNCHRONOUS DESIGN FOR PARALLEL PROCESSING ARCHITECTURES SemiAnnual Report, Jan. - Jun. 1990
Teresa H.-Y. Meng Jun. 1990 3 p
(Contract N00014-89-J-3036)
(AD-A223754) Avail: NTIS HC A01/MF A01 CSCL 12/5

The objective of this research is to provide an interconnect design synthesis methodology which facilitates a modular design approach without compromising the global performance. The main tasks of this effort will be the development of the theory for optimal interconnect synthesis from a high-level specification, with emphasis on testability and fault-tolerance asynchronous interface among concurrent computing hardware objects, and the application of this design methodology to physical implementations of parallel processing systems. GRA

N90-29982# Technische Hochschule, Darmstadt (Germany, F.R.). Fachbereich Informatik.
FACT SYSTEM: A STANDARDIZING MODELIZATION PROCESSING FOR CONCURRENT SYSTEMS Ph.D. Thesis [FAKTENSYSTEME: EIN VEREINHEITLICHENDER MODELLIERUNGSFORMALISMUS FUER NEBENLAEUFIGE SYSTEME]
Karlheinz Hug 1988 245 p In GERMAN
(ETN-90-97286) Avail: NTIS HC A11/MF A02

A formalism for the modelization of static and dynamic structure of systems with coordinated concurrency is presented. Process types, processes and process are abstracting views of dynamic fact systems. Parallel systems are part systems of parallel combined processes, for which the concurrency is limited by synchronization paths, which can be specified by regular expressions, static relations or dynamic predicates. The exclusion of dynamic fact systems under the homomorphisms and the operations of the parallel combination and the mean structure allow a complex system to be modeled as a hierarchy of systems of parallel processes and a modular bottom up checking to be obtained. These systems are particularly appropriate for communication systems. ESA

N90-29983# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction des Moyens d'Informatique.
PARALLELIZATION OF A METHOD FOR SOLVING THREE DIMENSIONAL NAVIER-STOKES EQUATIONS ON A DISTRIBUTED MEMORY MULTIPROCESSOR Final Report [PARALLELISATION D'UNE METHODE DE RESOLUTION DES EQUATIONS DE NAVIER-STOKES 3D SUR UN MULTIPROCESSEUR A MEMOIRE DISTRIBUEE, RAPPORT TECHNIQUE DE SYNTHESE]
D. Tromeur-Dervout, P. Leca, and L. Mane Dec. 1989 39 p In ENGLISH and FRENCH
(Contract DRET-89-34-001)
(ONERA-RTS-1/3717-CY; ETN-90-97565) Avail: NTIS HC A03/MF A01

Investigations on the parallelization of algorithms for solving Navier-Stokes equations are performed. Two codes for solving unsteady Navier-Stokes equations of incompressible flow are developed. Different algorithms for solving the Poisson equation of the three dimensional Navier-Stokes code are compared. The data management for three dimensional ADI algorithm on hypercube and the application to the design of a parallel Navier-Stokes solver are discussed. The results of a computerized simulation of a cavity under Reynolds number 200 are presented. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N90-29984*# National Inst. of Standards and Technology, Gaithersburg, MD. Robot Systems Div.
APPROACH TO TELEROBOT COMPUTING ARCHITECTURE
John Fiala and Ronald Lumia 18 Jun. 1990 25 p Sponsored by NASA, Goddard Space Flight Center
(NASA-CR-186993; NAS 1.26:186993; PB90-244419; NISTIR-4357) Avail: NTIS HC A03/MF A01 CSCL 09B

In response to a Goddard Space Flight Center effort to look at the requirements for a computing architecture design appropriate for a telerobot, the Intelligent Controls Group approach to telerobot computing architectures is described. It is shown how a seven microprocessor control system can achieve teleoperation with an around-the-loop time of 10 ms. The focus is on low-level, real-time robotics. GRA

N90-29985# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
DIRECT ESTIMATION OF STRUCTURE AND MOTION FROM MULTIPLE FRAMES
Joachim Heel Mar. 1990 70 p
(Contracts DACA76-85-K-0685; N00014-85-K-0124)
(AD-A223903; AI-M-1190) Avail: NTIS HC A04/MF A01 CSCL 14/5

A method is presented for the estimation of scene structure and camera motion from a sequence of images. This approach achieves fundamental improvements over existing methods in the following respects: (1) No computation of optical flow or feature correspondence is required as long as structure and motion are obtained directly from gradients of image brightness; (2) The method processes image sequences of arbitrary length and exploits the inherent redundancy for a significant reduction in error over time; and (3) No restrictions or assumptions are made about the camera motion or the the surface structure. Both quantities are fully recovered using this method. The method combines the direct motion vision approach of Horn, Weldon and Negahdaripour with the theory of recursive estimation. Most importantly, it really works and results are shown on a variety of real image sequences. GRA

N90-29986# Naval Weapons Center, China Lake, CA. Applied Mathematics Research Group.
OPTIMAL CONTROL LAW PHENOMENA IN CERTAIN ADAPTIVE SECOND-ORDER OBSERVATION SYSTEMS Final Report, Oct. 1988 - May 1989
Warren W. Willman Aug. 1989 44 p
(AD-A224274; AD-E900936; NWC-TP-7030) Avail: NTIS HC A03/MF A01 CSCL 12/9

By augmenting the state vector, a certain type of adaptive optimal control problem, which is of the standard multivariate linear-quadratic-Gaussian form except for a relatively small degree of uncertainty in some of its parameters, is formulated as a nonlinear stochastic optimal control problem with known parameters, some of which are small. GRA

N90-29987# Illinois Univ., Urbana. Knowledge Based Systems Group.
AN ANALYSIS OF THE DISTINCTION BETWEEN DEEP AND SHALLOW EXPERT SYSTEMS Technical Report, 1 Dec. 1987 - 30 Jan. 1991
Peter D. Karp (Stanford Univ., CA.) and David C. Wilkins Aug. 1989 54 p Submitted for publication
(Contracts N00014-88-K-0124; N00039-83-C-0136; NSF MCS-83-10236; RR-00785)
(AD-A224443; UIUCDCS-R-89-1536; UILU-ENG-89-1755) Avail: NTIS HC A04/MF A01 CSCL 12/5

The first generation of expert systems (e.g., MYCIN, DENDRAL, R1) is often characterized as only using shallow methods of representation and inference, such as the use of production rules to encode empirical knowledge. First-generation expert systems are often dismissed on the grounds that shallow methods have inherent and fatal shortcomings which prevent them from achieving problem-solving behaviors that expert systems should possess. Examples of such desirable behaviors include graceful performance degradation, the handling of novel problems, and the ability of the expert system to detect its problem solving limits. The relationship is analyzed between the techniques used to build expert systems and the behaviors they exhibit to show that there is not sufficient evidence to link the behavioral shortcomings of first-generation expert systems to the shallow methods of representation and inference they employ. There is only evidence that the shortcomings are a consequence of a general lack of knowledge. Moreover, it is shown that the first-generation of expert systems employ both shallow methods and most of the so-called deep methods. Lastly, it is shown that deeper methods augment but do not replace shallow reasoning methods; both are necessary. GRA

N90-29988# Mitre Corp., Bedford, MA.
MACHINE LEARNING Final Technical Report
Melissa P. Chase Apr. 1990 21 p
(Contract F19628-89-C-0001)
(AD-A223732; RADC-TR-90-25) Avail: NTIS HC A03/MF A01 CSCL 12/5

Our goal is to design and implement an intelligent planner that improves its own performance as it solves problems. This system, called ULS, is based upon explanation-based learning techniques, but addresses some of the weaknesses in that technology that become particularly apparent as it is applied to realistic problems. Our research has been specifically directed toward. the above-mentioned utility problem. Our approach to addressing the utility of learning is to approximate the results of explanation-based learning (Cha89, Zwe88). This year, our efforts were focused on improving the approximation techniques, defining new simplified domains, and conducting experiments in various domains. GRA

N90-29989# Lawrence Livermore National Lab., CA.
UNSTRUCTURED MESH RELAXATION
W. P. Crowley May 1990 9 p Presented at the Free-Lagrange Conference, Jackson Hole, WY, 3-7 Jun. 1990
(Contract W-7405-eng-48)
(DE90-015614; UCRL-JC-104630; CONF-9006195-8) Avail: NTIS HC A02/MF A01

The relationship between the human asking questions and the code providing answers is being revised currently; the trend is toward a situation wherein each partner does what he/she/it does best. The human excels at processes requiring thought, such as analyzing the results of a simulation, and organizing lists of things to do and guidelines for doing them. Currently, the computer excels at following instructions and doing tedious, repetitive tasks without error. Thus, the human should ask the questions -- set up geometries -- specify boundary and source conditions -- and analyze the results. The code should decide, dynamically, during the evolution of the problem, where to refine the mesh and which algorithms to use in which regions of the problem in order to provide both accuracy and robustness. The ultimate code will be based on an unstructured mesh. It will involve the ability to do Free-Lagrange and ALE (Arbitrary-Langrangian-Eulerian) and it will dynamically adapt the mesh to suit the problem at hand. It will be capable of adopting other hydro algorithms and of including other physics options. At its heart will be a mesh manager that will decide which option is appropriate for each region of the problem. Free-Lagrange methods, ALE on a structured mesh, and adaptation are existing technologies. ALE requires a method for relaxing the mesh in regions of high fluid distortion and we do not yet have a robust method for relaxing an unstructured mesh. This paper addresses that problem. DOE

N90-29808*# Grumman Aerospace Corp., Bethpage, NY. Advanced Systems.
CONTROL STRATEGIES FOR A TELEROBOT
John OHara and Bill Stasi *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 297-306 (For primary document see N90-29780 24-54)
(Contract NAS9-17229)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29816*# Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Inst.
REFLECTIONS ON THE RELATIONSHIP BETWEEN ARTIFICIAL INTELLIGENCE AND OPERATIONS RESEARCH
Mark S. Fox *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 383-394 Sponsored in part by Digital Equipment Corp. (For primary document see N90-29780 24-54)
(Contract F30602-88-C-0001)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29817*# Ohio State Univ., Columbus. Lab. for AI Research.
WHAT KIND OF COMPUTATION IS INTELLIGENCE. A FRAMEWORK FOR INTEGRATING DIFFERENT KINDS OF EXPERTISE
B. Chandrasekaran *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 395-402 (For primary document see N90-29780 24-54)
(Contract F30602-85-C-0010; AF-AFOSR-0090-87)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29818*# Edinburgh Univ. (Scotland). Dept. of Artificial Intelligence.
A DESIGN STRATEGY FOR AUTONOMOUS SYSTEMS
Pete Forster *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 403-414 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29819*# Michigan Univ., Ann Arbor. Artificial Intelligence Lab.
LEARNING IN TELE-AUTONOMOUS SYSTEMS USING SOAR
John E. Laird, Eric S. Yager, Christopher M. Tuck, and Michael Hucka *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 415-424 (For primary document see N90-29780 24-54)
(Contracts NCC2-517; N00014-88-K-0554)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29820*# Missouri Univ., Rolla. Dept. of Electrical Engineering.
DESIGN OF A STRUCTURAL AND FUNCTIONAL HIERARCHY FOR PLANNING AND CONTROL OF TELEROBOTIC SYSTEMS
Levent Acar and Umit Ozguner (Ohio State Univ., Columbus.) *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 425-434 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29829*# Massachusetts Inst. of Tech., Cambridge. Man-Machine Systems Lab.
USE OF GRAPHICS IN DECISION AIDS FOR TELEROBOTIC CONTROL: (PARTS 5-8 OF AN 8-PART MIT PROGRESS REPORT)
Thomas B. Sheridan, James B. Roseborough, Hari Das, Kan-Ping Chin, and Seiichi Inoue *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 3 31 Jan. 1989 p 533-541 (For primary document see N90-29780 24-54)
Avail: NTIS HC A23/MF A04 CSCL 05H

N90-29832*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DIRECT ADAPTIVE CONTROL OF A PUMA 560 INDUSTRIAL ROBOT
Homayoun Seraji, Thomas Lee, and Michel Delpech (Centre National d'Etudes Spatiales, Toulouse, France) *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 11-22 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29846*# Italian Space Agency, Rome.
INFORMATION MANAGEMENT IN AN INTEGRATED SPACE TELEROBOT
S. DiPippo, G. Pasquariello, and G. Sylos Labini *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 157-166 Prepared in cooperation with Istituto Elaborazione Segnali ed Immagini, Bari (Italy) (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29860*# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
RECURSIVE MULTIBODY DYNAMICS AND DISCRETE-TIME OPTIMAL CONTROL
G. M. T. DEleuterio and C. J. Damaren *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 285-295 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29880*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
PRESHAPING COMMAND INPUTS TO REDUCE TELEROBOTIC SYSTEM OSCILLATIONS
Neil C. Singer and Warren P. Seering *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 53-62 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29881*# Aerospace Corp., El Segundo, CA.
PERFORMANCE CONSTRAINTS AND COMPENSATION FOR TELEOPERATION WITH DELAY
J. S. McLaughlin and B. D. Staunton *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space

Telerobotics, Volume 5 31 Jan. 1989 p 63-72 Sponsored by AF (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29884*# Stanford Univ., CA.
INSTRUCTION DIALOGUES: TEACHING NEW SKILLS TO A ROBOT
Colleen Crangle and P. Suppes *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 91-101 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29886*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ESTABLISHING VIABLE TASK DOMAINS FOR TELEROBOT DEMONSTRATIONS
Wayne Zimmerman *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 111-120 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29888*# Ministry of International Trade and Industry, Tokyo (Japan). Electrotechnical Lab.
MULTI-LEVEL MANUAL AND AUTONOMOUS CONTROL SUPERPOSITION FOR INTELLIGENT TELEROBOT
Shigeoki Hirai and T. Sato *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 131-140 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29891*# National Inst. of Standards and Technology, Gaithersburg, MD.
REQUIREMENTS FOR IMPLEMENTING REAL-TIME CONTROL FUNCTIONAL MODULES ON A HIERARCHICAL PARALLEL PIPELINED SYSTEM
Thomas E. Wheatley, John L. Michaloski, and Ronald Lumia *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 163-172 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

N90-29906*# Martin Marietta Aerospace, Denver, CO. Astronautics Group.
AN EFFICIENT TEMPORAL LOGIC FOR ROBOTIC TASK PLANNING
Jeffrey M. Becker *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 311-320 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N90-29990# International Centre for Theoretical Physics, Trieste (Italy).
AN INSTABILITY THEOREM FOR A CERTAIN SIXTH ORDER DIFFERENTIAL EQUATION
Aydin Tiryaki (Erciyes Univ., Kayseri, Turkey) Dec. 1989 5 p Submitted for publication
(DE90-627150; IC-89/342) Avail: NTIS (US Sales Only) HC A01/MF A01

In the present paper we try to establish an instability theorem for the trivial solution of the sixth order differential equations. DOE

N90-29991# International Centre for Theoretical Physics, Trieste (Italy).
UNIFORM DISSIPATIVE SOLUTIONS FOR SOME FOURTH ORDER NONLINEAR DIFFERENTIAL EQUATIONS
Anthony Uyi Afuwape (Obafemi Awolowo Univ., Ile-Ife, Nigeria) Dec. 1989 18 p Submitted for publication
(DE90-627151; IC-89/395) Avail: NTIS (US Sales Only) HC A03/MF A01

The frequency domain method is used to prove that the solutions of some fourth order nonlinear differential equations are uniformly dissipative. This extends the applications of earlier results. DOE

N90-29992# International Centre for Theoretical Physics, Trieste (Italy).
AN EXISTENCE THEOREM FOR PERIODIC SOLUTIONS AND APPLICATIONS TO SOME THIRD ORDER NONLINEAR DIFFERENTIAL EQUATIONS
Anthony Uyi Afuwape and Fabio Zanolin (Udine Univ., Italy) Dec. 1989 24 p Submitted for publication Sponsored in part by Swedish Agency for Research Cooperation with Developing Countries
(DE90-627152; IC-89/396) Avail: NTIS (US Sales Only) HC A03/MF A01

An existence theorem is proven for periodic nonlinear ordinary differential equations with one-sided growth restrictions. Applications are given to some nonlinear third order differential equations. Earlier results of Ezeilo and Nkashama are thus extended. DOE

N90-29993# International Centre for Theoretical Physics, Trieste (Italy).
OSCILLATORY AND NONOSCILLATORY BEHAVIOUR OF SOLUTIONS OF AN EQUATION ALTERNATELY OF RETARDED AND ADVANCED TYPE
N. Parhi (Berhampur Univ., India) Dec. 1989 15 p Submitted for publication
(DE90-627159; IC-89/428) Avail: NTIS (US Sales Only) HC A03/MF A01

Sufficient conditions have been obtained for oscillation and nonoscillation of solutions of a nonlinear differential equation which is alternately of retarded and advanced type. DOE

N90-29994# International Centre for Theoretical Physics, Trieste (Italy).
PERIODIC SOLUTIONS OF CERTAIN FIFTH ORDER DIFFERENTIAL EQUATIONS
Aydin Tiryaki (Erciyes Univ., Kayseri, Turkey) Dec. 1989 10 p Submitted for publication
(DE90-627160; IC-89/432) Avail: NTIS (US Sales Only) HC A02/MF A01

In this paper, the sufficient conditions for the existence of periodic solutions of the certain fifth order differential equations are given. DOE

N90-29995# International Centre for Theoretical Physics, Trieste (Italy).
SOME OVERDETERMINED SYSTEMS OF COMPLEX PARTIAL DIFFERENTIAL EQUATIONS
Le Hung Son (Polytechnical Univ., Hanoi, Vietnam) Jan. 1990 13 p Submitted for publication
(DE90-627162; IC-90/10) Avail: NTIS (US Sales Only) HC A03/MF A01

Some properties of analytic functions on several complex variables are extended to solutions of overdetermined systems of complex partial differential equations. It is proved that many global properties of analytic functions are true for solutions of the Vekua system in special cases. The relation between analytic functions and solutions of quasi-linear systems is discussed. DOE

N90-29996# Universal Energy Systems, Inc., Dayton, OH.
TOOL FOR STUDYING THE EFFECTS OF RANGE RESTRICTION IN CORRELATION COEFFICIENT ESTIMATION Interim Report, Jun. 1988 - Jan. 1990
Douglas E. Jackson and Malcolm James Ree (Air Force Human Resources Lab., Brooks AFB, TX.) Jul. 1990 16 p Submitted for publication
(AD-A224035; AFHRL-TP-90-6) Avail: NTIS HC A03/MF A01 CSCL 12/3

It is sometimes necessary to estimate correlations in samples that have been range restricted due to selection. These correlations are often diminished when compared to their population values. A correction for this subject is a proof which is discussed in the context of a computer-aided simulation procedure to study the nature and behavior of the correction. GRA

N90-29997# Pittsburgh Univ., PA. Dept. of Mathematics and Sciences.
A POSTERIORI ERROR ESTIMATES FOR PARAMETRIZED NONLINEAR EQUATIONS
Werner C. Rheinboldt and Jinn-Lian Liu Jun. 1990 18 p
(Contract N00014-90-J-1025)
(AD-A224067; ICMA-90-151) Avail: NTIS HC A03/MF A01 CSCL 12/1

A new approach to the construction of a posteriori error estimates for finite element solutions of multiparameter nonlinear problems presented. The estimates are derived from local, element-by-element solutions of linearizations of the problems; they turn out to be very effective, computationally rather inexpensive, and insensitive to the choice of the local coordinate system on the solution manifold. Frequently, in practical computations in engineering and science, the aim is to obtain results which are sufficiently accurate and reliable to allow for a decision about the physical system under study. A posteriori error estimate plays a very important role in achieving this aim. Such estimates are needed not only for judging the reliability of the computed results but also for controlling adaptive processes designed to achieve desired error tolerances at minimal cost or best possible solutions within allowable cost ranges. GRA

N90-29998# Netrologic, Inc., San Diego, CA.
IMAGE COMPRESSION Interim Report No. 1, May - Jun. 1990
Jun. 1990 4 p
(Contract N00014-90-C-0124)
(AD-A224242) Avail: NTIS HC A01/MF A01 CSCL 12/1

Correlation methods for determining affine iterated function sets are investigated. The basic method is to compare portions of an image with other portions of the same image. The affine transformations which we choose by this process must therefore specify range and domain as well as gray level. Although the compressions attained by such codes run from 10:1, to 20:1, this method has the advantage of being completely automatic and requiring no pre-processing. Furthermore the image encoding is relatively rapid, requiring approx. 30 minutes for a 256 by 256 image, when the algorithm runs on a Sun 4 computer. The algorithm was run on 10 separate images. GRA

N90-29999# Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering.
ON EQUATIONS OF MOTION ON COMPLEX GRASSMAN MANIFOLD
S. Berceanu and A. Gheorghe Feb. 1989 31 p
(DE90-628369; IFIN-FT-347-1989) Avail: NTIS (US Sales Only) HC A03/MF A01

The equations of motion are investigated on the classical phase space which corresponds to quantum state space in the case of the complex Grassmann mannifold appearing in the Hartree-Fock problem. First and second degree polynomial Hamiltonians in bifermion operators are considered. The classical motion corresponding to linear Hamiltonians is described by a Matrix Riccati equation. DOE

N90-30000# Southern Methodist Univ., Dallas, TX. Dept. of Statistical Science.
SADDLEPOINT APPROXIMATIONS IN CONDITIONAL INFERENCE
Suojin Wang 11 Jun. 1990 16 p Submitted for publication
(Contract F19628-88-K-0042)
(AD-A223280; SMU/DS/TR-239; GL-TR-90-0141) Avail: NTIS HC A03/MF A01 CSCL 12/3

Conditional inference plays an important role in statistical inference. The conditionality principle has been used to deal with various problems. One major step in the procedure of conditional inference is to obtain the conditional distribution functions. As is often the case, the exact conditional distributions are difficult or impossible to obtain, and conventional approximations may often fail to work. For example, generally it is hard to calculate the moments of the conditional distributions which are necessary quantities for the Edgeworth approximations. Furthermore, these approximations are often unsatisfactory for small or moderate sample sizes. On the other hand, it is well known that saddlepoint expansions lead to accurate approximations, even for small sample sizes. This paper derives accurate saddlepoint expansions for the case of nonlinear conditioning. The results include Skovgaard's (1987) method as a special case when the distribution is continuous, but have much broader applications. Sections 2 and 3 expand saddlepoint formulas for the conditional density and conditional distribution function, respectively. Two examples are considered in Section 4 to illustrate the use of the new results. Extraordinary accuracy is also shown numerically. GRA

N90-30001# Illinois Univ., Urbana-Champaign. Dept. of Mathematics.
UNSTABLE PHENOMENA IN MECHANICAL SYSTEMS Interim Progress Report, 1 May 1988 - 30 Apr. 1990
Paul K. Newton May 1990 7 p
(Grant AF-AFOSR-0185-88; AF Proj. 2304)
(AD-A223640; AFOSR-90-0732TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This report has focused on the development of mathematical techniques to understand unstable physical processes with particular emphasis on dynamic behavior in fluids, plasmas, and multi-particle systems. The particular focus has been on the development of singular perturbation techniques to study amplitude equations arising in hydrodynamic stability theory, in particular the Ginzburg-Landau equation of fluid dynamics and the Zakharov equation of plasma physics. Two successful approaches have been developed to these problems. The first is directed at studying branching and bifurcation processes near nonlinear plane waves and the second approach focused on the singular (NLS) limit of the Zakharov system governing plasma turbulence. GRA

N90-30002# Princeton Univ., NJ. Dept. of Computer Science.
UNIQUE BINARY SEARCH TREE REPRESENTATIONS AND EQUALITY-TESTING OF SETS AND SEQUENCES
Rajamani Sundar and Robert E. Tarjan (Bell Telephone Labs., Inc., Murray Hill, NJ.) Nov. 1989 15 p
(Contracts N00014-85-K-0046; N00014-87-K-0467; NSF CCR-87-02271; NSF CCR-89-02221; NSF CCR-89-06949; NSF DCR-86-05962)
(AD-A223643; CS-TR-267-90) Avail: NTIS HC A03/MF A01 CSCL 12/5

Given an ordered universe U, the problem was studied of representing each subset of U by a unique binary search tree so that dictionary operations can be performed efficiently. Representations are exhibited that permit the execution of dictionary operations in optimal time when the dictionary is sufficiently sparse or sufficiently dense. Unique representations are applied to obtain efficient data structures for maintaining a collection of sets/sequences under queries that test the equality of a pair of objects. In the process, an interesting method for maintaining a dynamic, sparse array was derived. GRA

N90-30003# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
AUTOMATIC RECOGNITION OF TRACTABILITY IN INFERENCE RELATIONS Memorandum Report
David McAllester Feb. 1990 35 p
(Contract N00014-86-K-0124; NSF IRI-88-19624)
(AD-A223698; AI-M-1215) Avail: NTIS HC A03/MF A01
CSCL 12/4

A procedure is given for recognizing sets of inference rules that generate polynomial time decidable inference relations. The procedure can automatically recognize the tractability of the inference rules underlying congruence closure. The recognition of tractability for that particular rule set constitutes mechanical verification of a theorem originally proved independently by Kozen and Shostak. The procedure is algorithmic, rather than heuristic, and the class of automatically recognizable tractable rule sets can be precisely characterized. A series of examples of rule sets whose tractability is non-trival, yet machine recognizable, is also given. The technical framework developed here is reviewed as a first step toward a general theory of tractable inference relations. GRA

N90-30004# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.
ADAPTIVE, ROBUST, HIGH-RESOLUTION SIGNAL PROCESSING Final Report, 15 Jul. - 15 Jan. 1990
Donald W. Tufts 20 Mar. 1990 6 p
(Contract DAAL03-86-K-0108)
(AD-A223728; ARO-24373.20-MA-SDI) Avail: NTIS HC A02/MF A01 CSCL 12/1

Research results obtained during the three and one-half year period ending in January 1990 are summarized, and the papers are referenced in which the detailed results appear. The summary is separated into the following three areas: (1) The Arithmetic Fourier Transform (AFT), (2) Analysis of Performance of High-Resolution Signal Processing, and (3) Extending the Applicability of High-Resolution Signal Processing. GRA

N90-30005# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
SURVEY OF FORMAL SPECIFICATION TECHNIQUES FOR REACTIVE SYSTEMS Final Report
Patrick R. H. Place, William G. Wood, and Mike Tudball (Ferranti Computer Systems Ltd., Gwent, England) May 1990 136 p
(Contract F19628-89-C-0003)
(AD-A223741; CMU/SEI-90-TR-5; ESD-TR-90-218) Avail: NTIS HC A07/MF A01 CSCL 12/5

Formal methods are being considered for the description of many systems including systems with real-time constraints and multiple concurrently executing processes. A set of evaluation criteria is developed and Communicating Sequential Processes (CSP), the Vienna Development Method (VDM), and temporal logic is evaluated. The evaluation is based on specifications, written with each of the techniques, of an example avionics system. In software-intensive, reactive systems, many of the errors detected in the integration, testing, and installation stages of a system's development can be traced to ambiguities, inconsistencies, and incompleteness in the requirements specification. The removal of these errors often requires a considerable amount of backtracking of the system to discover the source of the error, followed by changes at many levels of the system's description to eliminate the cause of the error. For this reason it is advantageous to have a more precise, consistent, and complete specification of the system. The formal specification techniques evaluated are one way of developing specifications with the desired characteristics. GRA

N90-30006# Purdue Univ., West Lafayette, IN. Dept. of Statistics.
CLASSICAL AND BAYES-P SUBSET SELECTION PROCEDURES FOR DOUBLE EXPONENTIAL POPULATIONS
Shanti S. Gupta and Yuning Liao May 1990 23 p
(Contract N00014-88-K-0170; NSF DMS-87-02620)
(AD-A223830; TR-90-25C) Avail: NTIS HC A03/MF A01
CSCL 12/3

The exact distribution of the sample mean from a double exponential(Laplace) model is derived. A classical subset selection procedure based on the sample mean for selecting the population associated with the largest location parameter of k double exponential(Laplace) distributions is studied. For the case when a non-informative prior is introduced into the problem, the relation between the classical Maximum-Type Procedure Rule Rmax and the so-called Bayes-P* subset selection procedure rule is studied. An improved bound for the guarantee probability of a correct selection for the classical subset selection rule Rmax that relates the rule Rmax to the selected subset size (notice that the subset selection rule Rmax may select all the populations) is studied and some improved rules of the type Rmax are provided. GRA

N90-30007# Washington Univ., Seattle. Dept. of Applied Mathematics.
ADIABATIC INVARIANCE AND TRANSIENT RESONANCE IN VERY SLOWLY VARYING OSCILLATORY HAMILTONIAN SYSTEMS
D. L. Bosley and J. Kevorkian Jul. 1990 55 p
(Contract DE-FG06-86ER-25019)
(DE90-016118; DOE/ER-25019/18; TR-90-05) Avail: NTIS HC A04/MF A01

Canonical averaging techniques are applied to very slowly varying oscillatory systems in Hamiltonian standard form to very high orders, which are required for uniformly valid solutions. When resonance is exhibited in these systems N-1 adiabatic invariants are found, reducing the original system of 2N first-order differential equations which embody the resonance behavior. Three examples exhibiting transient resonance are examined. Transient resonance occurs when the leading order frequency of the reduced system makes a slow passage through zero. Depending on the rate of this slow passage, three distinguished cases are identified: the subcritical, the critical, and the supercritical. For each case, asymptotic solutions are found illustrating the nature of the resonance for certain classes of problems. In both the critical and supercritical cases, the action (and correspondingly the energy) can undergo changes of O(1) or greater. Specific examples are used to illustrate and numerically verify all results. DOE

N90-30008# Illinois Univ., Urbana. Dept. of Computer Science.
AN ALGEBRAIC HIERARCHICAL BASIS PRECONDITIONER M.S. Thesis
Renli Guo May 1990 42 p
(Contract DE-FG02-87ER-25026; NSF DMS-89-11410)
(DE90-015875; DOE/ER-25026/36) Avail: NTIS HC A03/MF A01

We consider the solution of linear system of equations Ax = b, where the coefficient matrix A satisfies the property: A(sup T) = A, a(sub ij) is less than or equal to 0 if i is nearly equal to j, and summation (sub j) a(sub ij) = 0 for all i. A algebraic hierarchical basis preconditioner is introduced motivated partly by electrical network problems. This preconditioner gives rise to a class of iterative methods, called clumping methods, to handle the linear system given above. A convergence proof is obtained for these methods and the convergence factor is also estimated. In addition, results of numerical experiment with clumping methods are presented. DOE

N90-30009# Technische Hochschule, Darmstadt (Germany, F.R.). Fachbereich Mathematik.
HYPERBOLIC HJELMSLEV GROUPS Ph.D. Thesis [HYPERBOLISCHE HJELMSLEVGRUPPEN]
Wilfred Vock 1988 96 p In GERMAN
(ETN-90-97298) Avail: NTIS HC A05/MF A01

The motion groups of hyperbolic planes above local commutative rings with unity groups are studied. The properties of projective Hjelmslev planes and a model of a local ring are given. The projective linear groups and the special orthogonal groups above a local ring with regular bilinear forms were

considered. Non-elliptic Hjelmslev groups at which Hjelmslev homomorphisms on metric non-euclidian groups exist were examined. An algebraic representation of the hyperbolic Hjelmslev groups was presented. ESA

N90-30010# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
A NEW LOOK AT CONJUGATE DIRECTION METHODS OF OPTIMIZATION
C. Storey May 1990 15 p Presented at the 2nd North America/German Workshop on Chemical Engineering Mathematics and Computation, Goettingen, Federal Rep. of Germany, 15-20 Jul. 1990
(MATHS-Rept-A-125; ETN-90-97600) Avail: NTIS HC A03/MF A01

Conjugate direction optimization methods using vectors but not matrices may be essential when computer storage is a limitation, as is often the case in chemical engineering problems. The effect of inexact line searches on conjugacy is used to develop some new, generalized, conjugate gradient algorithms with many attractive theoretical and numerical properties. The superiority of a generalized Polak-Ribiere algorithm over the NAG software library version of the Fletcher-Reeves algorithm is concluded. ESA

N90-30011# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
A COMPARISON OF ALTERNATIVE FAMILIES OF TRANSFORMATIONS FOR VARIABLES CONSTRAINED TO LIE ON THE INTERVAL (0,1)
J. R. Buxton Jun. 1990 17 p
(MATHS-Rept-A-126; ETN-90-97601) Avail: NTIS HC A03/MF A01

In modeling a response that is constrained to lie within a finite range, transformations such as the logit, probit or complementary log log are often used to give a better fit and to allow the use of a model with a simpler structure. Several attempts have been made to generalize these transformations by embedding them within a family of transformations indexed by one or more parameters. The aim of this study is to compare the transformations available within the different families. If the range of application of a model is such that the response of a model is always well clear of one end of the scale, the choice of transformation family will be relatively unimportant, and a simpler power or complementary power transformation will often suffice, but if the response takes on values close to both ends of the scale, the choice of transformation may be critical. With a single parameter family, a transformation that is optimal for one half of the response scale, may be quite inappropriate for values towards the opposite end of the scale. The two parameter families are much more flexible, with the different families offering a similar range of transformations. ESA

N90-30012# Royal Signals and Radar Establishment, Malvern (England). Pattern Processing Principles Section.
ASYMPTOTIC CODE VECTOR DENSITY IN TOPOGRAPHIC VECTOR QUANTISERS
Stephen P. Luttrell May 1990 33 p
(RSRE-Memo-4392; BR114336; ETN-90-97610) Copyright Avail: NTIS HC A03/MF A01

A noise robust vector quantizer model is used to derive expressions for the asymptotic code vector density in various types of topographic vector quantizers. A topographic vector quantizer is not identical to a standard (i.e., Kohonen) topographic mapping, but the differences are minimal. In all the cases studied (scalar and vector quantization with various symmetric topographic neighborhoods) an asymptotic result is obtained involving the input dimensionality and the input probability density. The asymptotic code vector densities of a topographic vector quantizer and a standard vector quantizer are thus shown to be the same. ESA

N90-30013# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SOLUTION OF NONLINEAR EIGENVALUE PROBLEMS VIA PARALLEL SHOOTING
E. L. Jansen Dec. 1989 84 p
(LR-587; ETN-90-97632) Avail: NTIS HC A05/MF A01

Inhomogenous boundary value problems for ordinary differential equations can be solved by numerical integration of corresponding initial value problems (shooting). Guesses for the unknown boundary values are iteratively adjusted until all prescribed boundary conditions are satisfied. The method of shooting and matching can also be applied to nonlinear eigenvalue problems by treating the eigenvalue as a parameter in this procedure, that is, as an unknown in the (Newton-type) iteration scheme. A shooting method is described, which simultaneously yields an eigenvalue and the corresponding eigenfunction. A normalization condition is added to the homogenous boundary value problem to make the eigenfunction unique. This method is applied to the bifurcation buckling of layered anisotropic cylinders under the combined loading of axial compression, radial pressure and torsion. The nonlinear Donnell type equations formulated in terms of the radial displacement W and an Airy stress function F are used. By Fourier decomposition for the circumferential direction the governing equations are reduced to a set of ordinary differential equations. Numerical results for a laminated glass epoxy shell are presented, showing the effects of different sets of boundary conditions and nonlinear prebuckling deformations. ESA

N90-29862*# Lockheed Engineering and Sciences Co., Houston, TX.
RECURSIVE NEWTON-EULER FORMULATION OF MANIPULATOR DYNAMICS
M. G. Nasser *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 309-318 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 12A

N90-29863*# San Diego State Univ., CA. Dept. of Mathematical Sciences.
KINEMATIC SENSITIVITY OF ROBOT MANIPULATORS
Marko I. Vuskovic *In* JPL, California Inst. of Tech., Proceedings of the NASA Conference on Space Telerobotics, Volume 4 31 Jan. 1989 p 319-328 (For primary document see N90-29830 24-54)
Avail: NTIS HC A19/MF A03 CSCL 12A

N90-29894*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A SPATIAL OPERATOR ALGEBRA FOR MANIPULATOR MODELING AND CONTROL
G. Rodriguez, Kenneth Kreutz, and Abhinandan Jain *In its* Proceedings of the NASA Conference on Space Telerobotics, Volume 5 31 Jan. 1989 p 193-204 Previously announced in IAA as A89-53452 (For primary document see N90-29874 24-54)
Avail: NTIS HC A19/MF A03 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N90-30014*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
USING MINIMAL SPANNING TREES TO COMPARE THE RELIABILITY OF NETWORK TOPOLOGIES
Karen J. Leister, Allan L. White, and Kelly J. Hayhurst Washington Oct. 1990 21 p
(NASA-TM-4208; L-16701; NAS 1.15:4208) Avail: NTIS HC A03/MF A01 CSCL 12A

Graph theoretic methods are applied to compute the reliability

for several types of networks of moderate size. The graph theory methods used are minimal spanning trees for networks with bi-directional links and the related concept of strongly connected directed graphs for networks with uni-directional links. A comparison is conducted of ring networks and braided networks. The case is covered where just the links fail and the case where both links and nodes fail. Two different failure modes for the links are considered. For one failure mode, the link no longer carries messages. For the other failure mode, the link delivers incorrect messages. There is a description and comparison of link-redundancy versus path-redundancy as methods to achieve reliability. All the computations are carried out by means of a fault tree program. Author

N90-30015# Naval Postgraduate School, Monterey, CA.
SENSITIVITY OF THE ERROR IN MULTIVARIATE STATISTICAL INTERPOLATION TO PARAMETER VALUES
Technical Report, Oct. 1987 - Mar. 1990
Richard Franke 9 Mar. 1990 69 p
(AD-A224076; NPS53-90-006) Avail: NTIS HC A04/MF A01 CSCL 12/3

The sensitivity of multivariate optimum interpolation to variations in values of it's parameters is investigated, including missing observation values. The influence of mis-specification of observation error and parameters in the spatial correlation function are also considered. The calculations are carried out on three different observations patterns: fairly uniform, partly uniform and partly sparse, and sparse. The decay rate of the correlation function is an important parameter to estimate properly and estimates of height and wind errors should be consistent. GRA

N90-30016# Florida State Univ., Tallahassee.
PROBLEMS IN PROBABILITY, STATISTICS, AND RELIABILITY
Final Report, 29 May 1986 - 27 Apr. 1990
Jayaram Sethuraman 1990 16 p
(Contract DAAL03-86-K-0094)
(AD-A224152; ARO-23699.27-MA) Avail: NTIS HC A03/MF A01 CSCL 12/3

This report describes the accomplishments in research during the grant. It lists the technical reports produced, followed by a list of published papers. The last section provides a summary of the research findings. GRA

N90-30017# Texas A&M Univ., College Station. Dept. of Statistics.
UNIFICATION OF STATISTICAL METHODS FOR CONTINUOUS AND DISCRETE DATA
Emanuel Parzen May 1990 23 p
(Contract DAAL03-90-G-0069)
(AD-A224307; TR-105) Avail: NTIS HC A03/MF A01 CSCL 12/3

Notation and concepts are introduced which establish unity and analogues between various steps of statistical data analysis, estimation, and hypothesis testing by expressing them in terms of optimization and function approximation using information criteria to compare two distributions. GRA

N90-30018# Texas A&M Univ., College Station. Dept. of Statistics.
TIME SERIES, STATISTICS, AND INFORMATION
Emanuel Parzen Jun. 1990 34 p
(Contract DAAL03-90-G-0069)
(AD-A224317; TR-113; ARO-27574.3-MA) Avail: NTIS HC A03/MF A01 CSCL 12/3

A broad survey was made of ideas for the future development of statistical methods of time series analysis based on investigating the many levels of relationships between time series analysis, statistical methods unification, and inverse problems with positivity constraints. It is hoped that developing these relations will help integrate old and new directions of research in time series analysis; provide research tools for applied and theoretical statisticians in the 1990's and coming era of statistical information; make possible unification of statistical methods and the development of Statistical Culture. New results include a new information divergence between spectral density functions. Topics discussed include: (1) Traditional entropy and cross-entropy; (2) Renyi and Chi-square information divergence; (3) Comparison density functions; (4) Approximation of positive functions (density functions) by minimum information divergence (maximum entropy); (5) Equivalence and Orthogonality of Normal Time Series; (6) Asymptotic Information of Stationary Normal Time Series; (7) Estimation of Finite Parameter Spectral Densities; (8) Minimum information estimation of spectral densities and power index correlations; (9) Tail classification of probability laws and spectral densities; and (10) Sample Brownian Bridge exploratory analysis of time series. GRA

N90-30019# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
TAIL AND QUANTILE ESTIMATION FOR STRONGLY MIXING STATIONARY SEQUENCES
Holger Rootzen, M. R. Leadbetter, and Laurens DeHaan (Erasmus Univ., Rotterdam, Netherlands) Apr. 1990 53 p Sponsored in part by National Research Council of Sweden
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A223472; TR-292; AFOSR-90-0698TR) Avail: NTIS HC A04/MF A01 CSCL 12/3

The estimation of tail parameters is examined for the marginal distribution F of the terms of a strongly mixing stationary sequence when 1-F(t) decreases exponentially, or is regularly varying as t infinity. The asymptotic properties of the Hill estimator for the exponential parameter or regular variation index are developed within this framework. Estimation procedures are investigated for tail probabilities and tail quantiles, both for the individual terms of the process and for their maxima over groups of consecutive terms. The latter case requires estimation of the so called extremal index, and substantially involves the local dependence structure of the sequence. GRA

N90-30020# Human Engineering Labs., Aberdeen Proving Ground, MD.
A NEW DIAGNOSTICS APPROACH FOR REPEATED MEASURES DESIGNS Final Report
Jock O. Grynovicki Jun. 1990 40 p
(DA Proj. 1L1-62716-AH-70)
(AD-A223500; HEL-TM-8-90) Avail: NTIS HC A03/MF A01 CSCL 12/3

The traditional univariate analysis of the repeated measures design is obtained by treating subjects and their associated interactions as random effects. This analysis requires that certain variances and covariances of the dependent variable at various combinations of within-subject factors are equal. Instability of the variance and covariance components may mask significant effects and may compel the researcher to use a less powerful multivariate technique. The number of subjects required in the multivariate approach is a function of the number of dependent variables and levels of the within-subject factors. Thus, the researcher may be forced to use a conservative degree-of-freedom adjustment instead, which may mask significant results if subject availability is limited. GRA

N90-30021# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
TRAPEZOIDAL STRATIFIED MONTE CARLO INTEGRATION
Elias Masry (California Univ., San Diego, La Jolla.) and Stamatis Cambanis Mar. 1990 32 p Submitted for publication
(Contracts F49620-85-C-0144; N00014-90-J-1175; AF Proj. 2304)
(AD-A223565; TR-286; AFOSR-90-0650TR) Avail: NTIS HC A03/MF A01 CSCL 12/3

Weighted integrals of random processes are approximated by the trapezoidal rule based on a stratified and symmetrized random sample of size n. The weight functions are assumed to be twice continuously differentiable. We consider the rate of convergence to zero of the mean-square integral approximation error as the sample size increases indefinitely. For random processes which are twice mean-square continuously differentiable it is shown that the rate is N to the minus 5th power, just as without a random

component. For random processes which are a bit more than once, but not twice, mean-square continuously differentiable the rate is shown to be N to the minus 4th power. In both cases the asymptotic constant is also determined. GRA

N90-30022# Technische Hochschule, Darmstadt (Germany, F.R.). Fachbereich Mathematik.
FOR THE DEFINITION OF TWO PERSON ZERO SUM GAMES Ph.D. Thesis [ZUR DEFINITHEIT VON ZWEIPERSONEN-NULLSUMMEN-SPIELEN]
Udo Krzensk 1988 76 p In GERMAN
(ETN-90-97294) Avail: NTIS HC A05/MF A01

The problem of conflict situations between two players is studied in the case of the minimax strategies. The topology of Banach spaces was used as well as the properties of linear functions to mathematically describe the problem. The risk area of the player was characterized by compact function spaces. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

No abstracts in this category.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N90-30023# International Centre for Theoretical Physics, Trieste (Italy).
THE LOCATION OF ZEROS USING GENERALIZATIONS OF NEWTON'S METHOD
Livinus Ugochukwu Uko Feb. 1990 12 p
(DE90-627168; IC-90/34) Avail: NTIS (US Sales Only) HC A03/MF A01

Generalizations of Newton's method are studied which terminate quadratically under adequate conditions and are occasionally faster than the standard Newton schemes. These methods also apply to problems involving functions which are not sufficiently regular to allow for the application of the classical method of Newton. In particular, the generalized schemes can be used to solve variational inequalities. Numerical examples are given. DOE

N90-30024# International Centre for Theoretical Physics, Trieste (Italy).
AN ERROR ESTIMATE FOR TREMOLIERES METHOD FOR THE DISCRETIZATION OF PARABOLIC VARIATIONAL INEQUALITIES
Livinus Ugochukwu Uko Feb. 1990 8 p
(DE90-627169; IC-90/35) Avail: NTIS (US Sales Only) HC A02/MF A01

We study a scheme for the time-discretization of parabolic variational inequalities that is often easier to use than the classical method of Rothe. We show that if the data are compatible in a certain sense, then this scheme is of order (ge)1/2. DOE

N90-30025# Academy of Sciences (USSR), Novosibirsk. Inst. Yadernoj Fiziki.
A CANONICAL INTEGRATION TECHNIQUE OF ARBITRARY ORDER
V. V. Vecheslavov 1989 15 p In RUSSIAN; ENGLISH summary
(DE90-628377; IYaF-89-35) Avail: NTIS (US Sales Only) HC A03/MF A01

An integration technique based on approximation of Hamiltonian differential equations by a canonical implicit map is described. One interaction of this map is equivalent to integration of Hamiltonian system over time interval (tau) with error (sigma)((tau)(sup n+1)), where n is order of the map. This approach may be used for obtaining any desired order. For performing the implicit map the scheme predictor-corrector is used with the explicit Lie map as the predictor. Both numerical and analytical ways of accuracy control are discussed. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N90-30026# Materials Research Labs., Ascot Vale (Australia). Scientific Services Div.
A REVIEW OF MANGANIN GAUGE TECHNOLOGY FOR MEASUREMENTS IN THE GIGAPASCAL RANGE
G. Yiannakopoulos Mar. 1990 72 p
(MRL-TR-90-5) Avail: NTIS HC A04/MF A01

A comprehensive review is presented of manganin gauge technology, including aspects of gauge design and construction, recording instrumentation and experimental techniques, and the interpretation of experimental results. Manganin gauges are shown to be capable of resolving to the order of 10 nanosecond pulses in the stress range 1 to 40 GPa. Author

N90-30027# Stanford Univ., CA. Dept. of Statistics.
HITTING LINES WITH TWO-DIMENSIONAL BROWNIAN MOTION
Satish Iyengar 27 May 1990 17 p
(Contract N00014-89-J-1627; NR Proj. 042-267)
(AD-A223595; TR-429) Avail: NTIS HC A03/MF A01 CSCL 12/3

This paper consists of the computation of several hitting time and hitting place distributions for two-dimensional Brownian motion. The motivation for this study is two-fold: first, to get a diffusion model for the firing behavior of a simple network of neurons, and second, to get an interesting two-dimensional version of the inverse Gaussian distribution. GRA

N90-30028# Naval Postgraduate School, Monterey, CA. Dept. of Electrical and Computer Engineering.
A REDUCED-ORDER EXTENDED KALMAN FILTER FOR MOVING IMAGES M.S. Thesis
Philip A. Lindeman Dec. 1989 108 p
(AD-A223742) Avail: NTIS HC A06/MF A01 CSCL 20/3

An extended Kalman filter is used to estimate the velocity of an object moving across an image frame and to reduce the undesirable effects of noise. The extended Kalman filter is implemented in the spatial frequency domain to reduce the number of computations. The resulting filter structure is a parallel bank of third-order extended Kalman filters. This parallel structure is referred to as the modified extended Kalman filter. The performance of the modified extended Kalman filter is evaluated under a variety of noise conditions using computer simulations. Simulations employed two test objects moving across a reference image in the presence of zero-mean, white, Gaussian noise. The performance of the filter was demonstrated when these objects were moved at integer and noninteger velocities. Performance was also evaluated when a stationary background was included with the white noise. GRA

N90-30029# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
INVESTIGATION OF THE APPLICATION IN THE SIMULATION PROGRAM 'PSPICE' OF THE JILES-ATHERTON MODEL FOR NONLINEAR MAGNETIC MATERIALS IN ORDER TO PREDICT THE DEGAUSSING OF MAGNETS
Ad vanderLinden Mar. 1990 45 p In DUTCH; ENGLISH summary
(LINO-1990-1; ETN-90-97534) Avail: NTIS HC A03/MF A01

The MicroSim computer code PSpice for the simulation of electrical circuits was used for the description of nonlinear magnetic properties, applying the Jiles-Atherton model. The PSpice results show no agreement with the obvious relation between the parameters of the model and the well known microscopic and macroscopic theory of magnetism. However, the results of a trial and error PSpice simulation of a degaussing circuit show quantitative agreement with experimental data of magnet steel of the firm 'Sigma phi'. Based onthese results, the degaussing behavior of the AFBU magnet B401 and the ESC magnets M1 and M4 are described. ESA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N90-30030# National Aerospace Lab., Tokyo (Japan).
PARAMETRIC STUDIES OF ACOUSTIC DUCT ATTENUATION OFPERFORATED-PLATE-ON-HONEYCOMB ABSORBER
Minoru Watanabe, Katsumi Takeda, and Tadao Torisaki Feb. 1989 43 p In JAPANESE; ENGLISH summary
(NAL-TM-603; ISSN-0452-2982; JTN-90-80190) Avail: NTIS HC A03/MF A01

Parametric studies of acoustic duct attenuation of perforated-plate-on-honeycomb absorbers were conducted using a flow duct facility with duct air flow Mach number from -0.6 to 0.6. Open area ratio of face sheets from 0.01 to 0.09 and core depth from 10 to 40 mm were tested with constant duct size of 200 mm. The influence of these parameters as well as duct air flow Mach number was discussed. NASDA

N90-30031 Stanford Univ., CA.
THE COMPUTATION AND ANALYSIS OF ACOUSTIC WAVES IN TRANSONIC AIRFOIL-VORTEX INTERACTIONS Ph.D. Thesis
James Douglas Baeder 1989 159 p
Avail: Univ. Microfilms Order No. DA9011450

The propagation characteristics of acoustic waves due to the interaction between a vortex and a helicopter airfoil were computed for a wide variety of methods, ranging from linearized transonic small disturbance to thin-layer Navier-Stokes. The analysis of the data from these methods showed that the accurate calculation of the acoustics required a computational method that not only accurately calculated the aerodynamics on the airfoil, but also properly preserved and propagated the wave as it left the surface. This resulted in improvements to the transonic small disturbance formulation for transonic airfoil-vortex interactions. Several post-processing techniques were developed to display the most important information from the computations. The Euler equations were found to be the most effective for calculating typical transonic airfoil-vortex interactions. Thus, they were utilized to study the effect of transonic flow on the formation process of the acoustic wave, resulting in significant new insight. Next, various parameters were studied. It was shown that in the linear subsonic regime the strength of the propagating wave varies with the sixth power of the Mach number; while, in the nonlinear transonic regime this power is smaller. It was also shown that in the transonic regime, the sign of the vortex was very important; suggesting that in the transonic regime one should avoid situations which results in clockwise vortices passing above the airfoil. The most important parameters governing transonic airfoil-vortex interaction noise were the Mach number, the vortex miss-distance, vortex strength and the sign of the vortex. Surprisingly, the airfoil shape and shock wave motions had relatively little effect on the transonic airfoil-vortex interaction noise. Dissert. Abstr.

N90-30032 State Univ. of New York, Stony Brook.
STUDY OF THE REFLECTION OF SURFACE ACOUSTIC WAVE FROM A MATERIAL DISCONTINUITY BOUNDARY USING A PERTURBATION METHOD Ph.D. Thesis
Chuk-Lam Yuen 1989 247 p
Avail: Univ. Microfilms Order No. DA9015638

A perturbation theory is developed to describe the reflection of surface acoustic wave (SAW) from a material discontinuity in an isotropic medium. When a surface acoustic wave travels in a medium and encounters a discontinuity in the mechanical property of the medium, its energy will be partially reflected. An isotropic medium can be characterized by the two Lame constants, lambda, mu, and the density rho of the material. When a surface wave passes through a boundary from a medium characterized by lambda, mu and rho to another medium characterized by lambda', mu', and rho', where any one or more of these 3 constants are different, the surface wave will be partially reflected. In the case where the 3 constants are only slightly different from each other, the perturbation theory developed can be used to describe the reflection behavior of the wave. Experiments were also performed to study the reflection behavior of the surface wave. Different transducer configurations were designed and fabricated and the reflection of the surface wave measured. Results showed good agreement with the predictions from the theory. The result has a very significant impact not only on the general understanding of surface wave propagation but also on the practical side of SAW application. The result can be employed to improve the performance of a variety of different SAW devices and also extend the application of SAW device into new areas where it previously could not be reached. Dissert. Abstr.

N90-30033# Naval Postgraduate School, Monterey, CA.
NUMERICAL PULSE PROPAGATION STUDIES USING TWO CLASSICAL OCEAN WAVEGUIDE MODELS M.S. Thesis
Marinos P. Markopoulos Dec. 1989 90 p
(AD-A224118) Avail: NTIS HC A05/MF A01 CSCL 20/1

Numerical pulse propagation studies using two classical ocean waveguide models are performed. The first model is a pressure-release surface with a rigid bottom. The second model is a pressure-release surface with a fluid bottom. The analysis of the two models is based on normal mode theory assuming a constant speed of sound in the ocean. The magnitude and phase of the complex acoustic pressure field as a function of frequency is calculated across a planar array of hydrophones. The time-domain output electrical pulse from the center element in the array is also computed. The computer simulation results for the two models are compared and discussed. GRA

N90-30034# Pennsylvania State Univ., University Park. Applied Research Lab.
ANGLE SAMPLE VARIANCE OF AZIMUTHALLY SPREAD SCATTERING PROCESSES, USING A TWO-ELEMENT ARRAY
J. R. Johnescu and D. W. Ricker Jul. 1990 78 p
(Contract N00039-88-C-0051)
(AD-A223572; PSU/ARL/TR-90-009) Avail: NTIS HC A05/MF A01 CSCL 17/1

Active echo energy received by a two-element array may be comprised of both spatially coherent and spatially spread scattering processes (such as clutter or reverberation) and isotropic noise. Such inputs may be filtered by a correlation receiver from which range, Doppler and angle estimates can be made. In many cases, these estimates display azimuthal support, such that angle estimates of spatially spread scattering processes are stochastically distributed across the array beamwidth, whereas angle estimates of spatially coherent scattering processes tend to be azimuthally compact. A scattering function model is used to relate the geometry and scattering distributions to the angle estimation problem when a two-element array is used as the receiver. The angle estimate statistics are described by probability density functions which depend upon array geometry, scattering distribution, scattering strength and ambient noise. When multiple measurements of angle are available, the sample variance can be useful as a means to characterize the underlying scattering distribution. Probability density functions of angle sample variance as a function of coherent scattered energy, diffuse scattered energy and ambient noise are developed through a multistep statistical transformation and verified with Monte Carlo estimations. GRA

N90-30035# BBN Systems and Technologies Corp., Canoga Park, CA.
AUDIBILITY AND ANNOYANCE OF EN ROUTE NOISE OF UNDUCTED FAN ENGINES Final Report
S. A. Fidell, L. A. Hutchings, M. Helweg-Larsen, and L. A. Sivati Apr. 1990 57 p
(Contract F33615-86-C-0530)
(AD-A223687; BBN-7212; DOT/FAA/EE-90-03) Avail: NTIS HC A04/MF A01 CSCL 20/1

Aircraft flyovers heard in high ambient noise urban environments are composed in large part of high absolute level, broadband noise. In contrast, noise exposure created en route by aircraft powered by unducted fan engines is expected to be relatively low in level, but to contain prominent low frequency tonal energy. These tones may be readily audible in low ambient noise rural environments. The annoyance of noise intrusions of low absolute level has been shown to be closely related to their audibility. Thus, one way to predict the annoyance of high altitude overflights by aircraft equipped with unducted fan engines is to estimate their audibility relative to that of conventionally powered aircraft in various ambient noise conditions. These predictions may be converted into estimates of the probability of high annoyance by means of a dosage-response relationship derived from laboratory data about the annoyance of individual noise intrusions. The latter estimates may in turn be applied to populations exposed to unducted fan engine noise over a range of assumed exposure levels. Application of these procedures to several assumed exposure cases suggests that millions of people in rural areas of the United States would be likely to be highly annoyed by the noise of aircraft powered by unducted fan engines. GRA

N90-30036# BBN Systems and Technologies Corp., Canoga Park, CA.
ASSESSMENT SYSTEM FOR AIRCRAFT NOISE (ASAN): DEVELOPMENT OF ALPHA-TEST PROTOTYPE SYSTEM SOFTWARE Final Report, Oct. 1988 - Nov. 1989
Nicholaas H. Reddingius and John S. Smyth Feb. 1990 22 p
(Contract F33615086-C-0530; AF Proj. 3037)
(AD-A223770; Rept-7227; HSD-TR-90-005) Avail: NTIS HC A03/MF A01 CSCL 12/5

The Alpha-Test version of the Assessment System for Aircraft Noise (ASAN) is described. ASAN was developed for the United States Air Force's Noise and Sonic Boom Impact Technology Advanced Development Program Office (NSBIT ADPO). The Purpose of ASAN is to provide Air Force route and environmental planners with a set of tools for preparing the noise portion of environmental impact statements (EIS), environmental assessments (EA), and findings of no significant impact (FONSI). ASAN provides a consistent set of procedures and models which represent the current state-of-the-art in noise engineering practice. A brief overview is given of the technical issues of developing the ASAN system. GRA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N90-30037# Kent State Univ., OH. Dept. of Physics.
NUCLEUS-NUCLEUS COLLISIONS AND THE NUCLEAR EQUATION OF STATE Progress Report, 15 Aug. 1989 - 4 May 1990
Declan Keane 1990 14 p
(Contract DE-FG02-89ER-40531)
(DE90-015427; DOE/ER-40531/1) Avail: NTIS HC A03/MF A01

An analysis was made of existing experimental data from the Bevalac streamer chamber and from the Kent state neutron flow experiment 848H; transport model were compared with these data and with published results from other experiments. Future Bevelac experiment were developed, with particular emphasis on the EOS Time Projection Chamber (TPC). The PI is spokesperson for one of three beam-time proposals for the first round of experiments at the EOS TPC, to be considered by the Bevalac PAC in June 1990. Planned activities for the coming budget period include a continuation of strong emphasis on the TPC, and the initiation of participation in a planned RHIC experiment. DOE

N90-30038# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
HIGHER ORDER EQUATIONS OF MOTION
C. G. Bollini and J. J. Giambiagi (Centro Latinoamericano de Fisica, Rio de Janeiro, Brazil) 1989 15 p Submitted for publication
(DE90-627522; CBPF-NF-044/89) Avail: NTIS (US Sales Only) HC A03/MF A01

The possibility that the motion of elementary particles can be described by higher order differential equations induced by supersymmetry in higher dimensional space-time is discussed. The specific example of six dimensions writing the corresponding Lagrangian and equations of motion, is presented. DOE

N90-30039# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
PROPAGATION OF CHAOS AND THE MCKEAN-VLASOV EQUATION IN DUALS OF NUCLEAR SPACES
T. S. Chiang, G. Kallianpur, and P. Sundar (Louisiana State Univ., Baton Rouge.) May 1990 48 p Submitted for publication
(Contract F49620-85-C-0144; AF Proj. 2304)
(AD-A224431; TR-298; AFOSR-90-0804TR) Avail: NTIS HC A03/MF A01 CSCL 12/3

The propagation is studied of chaos problems for systems with an infinite number of degrees of freedom such as strings or spatially extended neurons. The investigation of the asymptotic behavior of the voltage (membrane) potentials of large assemblages of interacting neurons leads to precisely such problems and provided the immediate motivation for the work. Another example to which this approach could be applied is the Ginsburg-Landau model in hydrodynamics. Basic properties of duals of nuclear spaced (denoted throughout by Psi, the strong dual of a countably Hilbertian nuclear space Psi) are briefly discussed and the results fo Kallianpur et al. on the existence and uniqueness of the solution to (the martingale problem posed by) a Psi-valued stochastic differential equation (SDE) is extended to a system of such equations. The principal results in which the infinite dimensionality of the problem call for special arguments are derived. GRA

N90-30040# Arizona Univ., Tucson.
OPTICAL EMISSIONS FROM BOMBARDING ATMOSPHERIC GASES WITH HEAVY IONS Final Report, 3 Aug. 1987 - 31 Dec. 1988
Stanley Bashkin 30 Oct. 1989 173 p
(Contract F19628-87-K-0052; AF Proj. 2310)
(AD-A223544; GL-TR-89-0117) Avail: NTIS HC A08/MF A01 CSCL 20/5

The optical emissions were studied from both nitrogen and oxygen targets contained in a differentially pumped cell and bombarded by particles of H3(+) with an energy of 1 MeV. The radiation was analyzed with a 1-meter air Czerny-Turner spectrometer capable of providing an instrumental line width of 0.01 nm. We covered the range from 320 to 850 nm. Most of the work was done with a line width of 0.1 nm, and some with a smaller value. Numerous lines from excited states in monatomic emitters and bands from states in molecular systems were observed. Relative intensities of the lines were measured and compared with values in the experimental literature and also with calculated transition probabilities. There was poor agreement with the experimental data provided by others, but excellent agreement with the theory. This light source is clearly superior to most others for the measurement of relative line intensities. The nitrogen data failed to show any lines from neutral atoms, although such lines are seen when electrons are the initiating particles. On the other hand, oxygen shows very strong lines from the neutral atom; both nitrogen and oxygen show lines from the singly ionized atom. While the nitrogen data reveal contributions from both the neutral

and singly ionized molecules, the oxygen shows bands only from the molecular ion. GRA

N90-30041*# Fermi National Accelerator Lab., Batavia, IL.
EFFECTIVE ACTIONS FOR BOSONIC TOPOLOGICAL DEFECTS
Ruth Gregory Jul. 1990 12 p
(Grant NAGw-1340)
(NASA-CR-187271; NAS 1.26:187271; FERMILAB-Pub-90/157-A)
Avail: NTIS HC A03/MF A01 CSCL 20H

A gauge field theory is considered which admits p-dimensional topological defects, expanding the equations of motion in powers of the defect thickness. In this way an effective action and effective equation of motion is derived for the defect in terms of the coordinates of the p-dimensional worldsurface defined by the history of the core of the defect. Author

N90-30042# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
MEDIUM ENERGY NUCLEAR PHYSICS RESEARCH Progress Report, 1 Oct. 1989 - 30 Jun. 1990
G. A. Peterson, J. F. Dubach, R. S. Hicks, and R. A. Miskimen Jun. 1990 59 p
(Contract DE-FG02-88ER-40415)
(DE90-015852; DOE/ER-40415/15) Avail: NTIS HC A04/MF A01

This report discusses papers on the following topics: Electroexcitation of Discrete Levels in C-13 at High Momentum Transfers; Elastic Magnetic Electron Scattering from Ca-^1; Threshold Electrodisintegration of the Deuteron at High Momentum Transfers; Transverse Form Factors of Sn-117; Longitudinal and Transverse Electron Scattering from Li-7; Large Momentum Transfer Electron Scattering from the Deuteron at 180 degrees; Determination of Nucleon Charge and Magnetic Form factors at Q(sup 2) = 1.4 to 6 (GeV/c)(sup 2); The PEGASYS Proposal: An Internal Gas Jet Target Facility for SLAC's PEP Storage Ring; Work at the University of Illinois Microtron: Coincidence Studies of the Giant Multipole Resonance in Sn-116; Using (e,e'n) Reaction; Experiments Performed and Planned at Bates, NIKHEF, and Lund: Complementary Studies of the 1p(sub 3/2) Radial Wave Function and Mechanisms for Proton Knockout by Real and Virtual Photons; The Preparation of a Review Paper on Giant Magnetic Resonances; and Participation in a Giant Resonance Coincidence Study. DOE

N90-30043# Technische Hochschule, Darmstadt (Germany, F.R.). Fachbereich Physik.
EMISSION OF QUICK NEUTRONS AND NON-EQUILIBRIUM PHENOMENA BY CENTRAL SHOCKS IN THE REACTION 40 Ar + 40 Ca AT 20 MeV/u Ph.D. Thesis [EMISSION SCHNELLER NEUTRONEN UND NICHTGLEICHGEWICHTSPAENOMENE BEI ZENTRALEN STOESSEN IN DER REAKTION AR40+CA40 BEI 20MEV/U]
Wilfried Roesch 1988 87 p In GERMAN
(ETN-90-97296) Avail: NTIS HC A05/MF A01

Neutrons and light charged particles are detected with a heavy ion accelerator for the examination of the preequilibrium nucleons, in coincidence with the residual evaporation nuclei. By the heavy reaction products a separation of these nuclei from the products of peripheral shocks is possible. The measured defective cross sections of the nuclei as functions of the mass were obtained by a statistical model. The measured data under forward angles of light charged particles allowed the separation of protons, deuterions and tritons. The measured energy spectra of the neutrons showed a highly energetic component along the radiation axis. A quantum mechanics phase model produced the neutrons multiplicities and showed that the equilibrium is quickly reached and the nucleon-nucleon shocks must be taken into account, described by the nucleon exchange transport model, an extension of the Fermi jet model. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

N90-30044# Lawrence Livermore National Lab., CA.
PROSPECTS FOR NUCLEAR ASTROPHYSICS WITH INTENSE RADIOACTIVE ION BEAMS
G. J. Mathews Jul. 1990 18 p Presented at the Workshop on the Science of Intense Radioactive Ion Beams, Los Alamos, NM, 10-12 Apr. 1990
(Contract W-7405-eng-48)
(DE90-015616; UCRL-JC-104603; CONF-9004209-6) Avail: NTIS HC A03/MF A01

An overview is made of the current and future nuclear data needs in nuclear astrophysics. Subjects discussed include: hydrogen burning reactions in various environments; big-bang nucleosynthesis (particularly with baryon-number inhomogeneities); heavy-element nucleosynthesis; and presupernova cores. A wish list is constructed of most desired unknown reaction rates in each of these areas. It is concluded that a facility for producing heavy-ion radioactive nuclear beams may provide a means to determine many of these reaction rates. DOE

N90-30045*# Michigan Univ., Ann Arbor.
HEAVY NUCLEUS COLLECTOR (HNC) PROJECT FOR THE NASA LONG DURATION EXPOSURE FACILITY (LDEF) Final Report
Gregory Tarle Sep. 1990 94 p
(Contract NAS1-17820)
(NASA-CR-182094; NAS 1.26:182094) Avail: NTIS HC A05/MF A01 CSCL 20G

The primary goal of the heavy nucleus collector (HNC) experiment was to obtain high resolution composition measurements for cosmic ray nuclei in the platinum-lead and actinide region of the periodic table. Secondary objectives include studies of selected groups of elements of lower charge. These goals were to be realized by orbiting a large area array of dielectric nuclear track detectors in space for several years. In this time sufficient actinide nuclei would be collected to determine the nucleosynthetic age of the cosmic radiation and the relative mix of r- and s-process elements in the cosmic ray source. The detector consists of approximately 50 trays assembled in pressurized canisters. Each tray would contain 8 half-stacks (4 stacks total) and an event thermometer which would record the temperature of each event at the time of exposure. Each stack would contain 7 layers of Rodyne-P, CR-39 and Cronar plastic track detectors interleaved with copper stripping foils. Upon return to Earth, detectors would be removed for analysis. Ultraheavy nuclei would have left tracks through the detector sheets that would be made visible after etching in a hot sodium hydroxide solution. Author

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N90-30046# Helsinki Univ. (Finland). Electromagnetics Lab.
POLARIZATION CORRECTION OF LUNEBURG LENS WITH CHIRAL MEDIUM
A. J. Viitanen, I. V. Lindell, and A. H. Sihvola Oct. 1989 18 p
(PB90-189127; ISBN-951-22-0037-6; Rept-53) Avail: NTIS HC A03/MF A01 CSCL 20F

Geometrical optics method for the wave propagation in inhomogeneous chiral media introduced recently is here applied to the Luneburg lens antenna. For sufficiently small values of the chirality parameter, the geometrical optics rays can be calculated as for the achiral medium. The main effect of the chirality is rotation of polarization along the ray. This effect can be exploited to correct

the polarization in the aperture of a lens antenna. Here, the cross polarization of the Luneburg lens is eliminated through use of an inhomogeneous chirality distribution. GRA

N90-30047# Naval Postgraduate School, Monterey, CA.
ESTABLISHMENT OF A CAPABILITY TO MEASURE OPTICAL TRANSITION RADIATION M.S. Thesis
Peter Karl Dallman Dec. 1989 103 p
(AD-A224094) Avail: NTIS HC A06/MF A01 CSCL 20/7

Optical transition radiation (OTR) can be used as a beam diagnostic system for charged particle beams. The experimental setup developed here demonstrates the capability to observe and measure OTR due to an electron beam from a linear accelerator. The setup is compact, simple, and readily adapted to experimental work. Through the use of two software programs (QuickCapture and Image 1.14) and the QuickCapture frame grabber board, both qualitative and quantitative results are possible. One of the useful qualitative results is a 3-D beam profile, which is quickly produced from a captured image. The system measured the relative intensity with a 3 percent variation between several images of the same source. Angular measurements of OTR can be made with an angular resolution of 600 microradians. GRA

N90-30048# Chemical Research and Development Center, Aberdeen Proving Ground, MD. Research Directorate.
REAL-TIME CONCENTRATION MONITORING OF LARGE AERODYNAMIC DIAMETER FIBER AEROSOLS USING THE GEOMETRIC OPTIC INVERSION TECHNIQUE Final Report, May 1986 - Jun. 1990
R. J. Wright, J. F. Embury, and D. H. Anderson Jun. 1990 12 p
(DA Proj. 1C1-62622-A-552)
(AD-A224167; CRDEC-TR-194) Avail: NTIS HC A03/MF A01 CSCL 20/6

Characterization of screening aerosols requires a measurement of the concentration of the aerosol cloud. For large aerodynamic diameter materials this is not always feasible. An alternate method, using geometric optic inversion, is described and derived. This inversion employs measurement of the transmission through the material by a short wavelength energy beam, such as helium neon laser. The transmission is then used to calculate the concentration of the material. Cloud concentrations calculated by this method are compared to measured concentrations, employing a unique sampling filter. GRA

N90-30049# Rochester Univ., NY. Inst. of Optics.
EFFECTS AND CONTROL OF THE CORRELATION PROPERTIES OF LIGHT SOURCES Ph.D. Thesis
Dean Faklis May 1990 142 p Sponsored in part by New York State Center for Advanced Optical Technology
(Contract DAAL03-86-K-0173)
(AD-A224539; ARO-24626.146-PH-UIR) Avail: NTIS HC A07/MF A01 CSCL 20/6

Several topics associated with the influence and control of the statistical properties of light are investigated. One topic is the modification of the observed spectrum by the correlation properties of a partially coherent secondary source. Source correlations that violate a certain scaling condition give rise to a normalized spectrum in the far zone that is different from the normalized spectrum of the light at the source. Statistical correlations can give rise to frequency shifts in the spectrum observed in the far field if the correlation function of the emitted radiation does not satisfy the scaling condition. A Fourier achromat is used to generate a secondary source in which the degree of spatial coherence is independent of wavelength; i.e., it violates the scaling condition. The spectrum detected in the far zone of the secondary source is displaced in frequency and distorted relative to the spectrum measured at the secondary source. The displacement depends on the direction of observation. A new method generates partially coherent sources with controllable correlation. Experiments described the feasibility of synthesizing source correlations for use in spectral modulation applications. The secondary source with controlled correlation uses an interferometric optical system designed and constructed around a general spectral filter. The degree of spectral coherence is directly related to the passboard of the filter. The calculation of the correlation properties of synchrot GRA

N90-30050# Wyatt Technology Co., Santa Barbara, CA.
SUBMICRON PARTICLE ANALYZER Report, May 1985 - Dec. 1987
Philip J. Wyatt and Christian Jackson Apr. 1990 30 p
(Contract DAAA15-85-C-006)
(AD-A223558; CRDEC-CR-067) Avail: NTIS HC A03/MF A01 CSCL 20/6

Two submicron aerosol particle analyzers of increasingly complex design were developed. The final objective of this program was the development of a real time aerosol characterization and identification system for particles in the 100 to 1500 nanometer size range. Two completed systems were delivered to the Army contractor. Each system was able to collect the light scattered from individual aerosol particles at, respectively, 16 and 24 angles. Data at all angles can be collected at rates in excess of 200 particles per second. Major breakthroughs were made in the design and implementation of real time data processing hardware, but due to budget limitations, this incomplete software aspect of the system was not incorporated into the final design. GRA

N90-30051# Colorado Univ., Boulder. Dept. of Electrical and Computer Engineering.
OPTICAL SIGNAL COMPUTING Final Report, 1 May 1986 - 31 Dec. 1989
Wade Thomas Cathey, Rodney A. Schmidt, and Garret Moddel 31 Dec. 1989 20 p
(Grant AF-AFOSR-0189-86; AF Proj. 2305)
(AD-A223624; Rept-1536920; AFOSR-90-0671TR) Avail: NTIS HC A03/MF A01 CSCL 12/6

Architectures for optical symbolic computing were designed, devices were designed and built that were specifically for the architectures, and test circuits for some of the logic elements were designed, constructed, and operated. The research elements were designed, constructed, and operated. The research led to novel architectures for optical symbolic computing. Devices were developed that are suitable for optical 2-D memory and logic. These devices are pixilated photo-addressed spatial light modulators (SLMs) with a three terminal arrangement so that the threshold can be adjusted. Spinoff non-pixilated devices are useful as high frame rate, high resolution SLMs that can be used for many optical signal processing applications. GRA

N90-30052# San Diego State Univ., CA.
SPECIAL PURPOSE SPATIAL LIGHT MODULATORS Final Report, Oct. 1988 - Mar. 1989
Mar. 1990 16 p
(Contract N66001-87-D-0136)
(AD-A223794; NOSC/TD-1776) Avail: NTIS HC A03/MF A01 CSCL 09/3

This document provides results of improvements of the quality of laser-crystallized silicon film of lead lanthanum zirconate titanate (PLZT). Dual-beam crystallization to optimize the PLZT film growth conditions by magnetron sputtering was used to study different GaAs growth conditions on sapphire and to measure various organic electro-optic modulator characteristics provided by Celanese. GRA

N90-30053# George Mason Univ., Fairfax, VA.
ANALYSIS AND EVALUATION OF TECHNICAL DATA ON THE PHOTOCHRONIC AND NON-LINEAR OPTICAL PROPERTIES OF MATERIALS Quarterly Technical Report No. 6
Robert F. Cozzens 25 Jun. 1990 34 p
(Contract DAAB07-89-C-F404; ARPA Order 6631; DA Proj. CJ8-29178-CJCA)
(AD-A223855) Avail: NTIS HC A03/MF A01 CSCL 11/7

Technical support was provided to DARPA and CNVEO at Fort Belvoir in evaluating and assessing data on materials, especially polymers, that may be useful in the development of optical limiters

and switches. The Principal Investigator was appointed by the former DARPA program manager for this project to be part of an ad hoc Technical Advisory Committee. Due to changes in the overall direction of the program, this committee has not formally met during this quarter. GRA

N90-30054# Sandia National Labs., Albuquerque, NM.
A COMPACT REAL-TIME ACOUSTO-OPTIC IMAGE CORRELATOR
Polly A. Molley, K. Terry Stalker, and William C. Sweatt 1990 8 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990 Sponsored in part by Army Missile Command
(Contract DE-AC04-76DP-00789)
(DE90-015564; SAND-89-3009C; CONF-900756-24) Avail: NTIS HC A02/MF A01

The design and development of a compact acousto-optic image correlator capable of performing real-time correlations on grayscale imagery will be described. The system utilizes one-dimensional optical devices to perform the desired two-dimensional correlation. The two-dimensional correlation is performed as a series of multichannel time-integrating correlations between each input image line and a reference template that is stored in an electronic memory. The rows of the reference template are introduced into the processor in parallel using a one-dimensional laser diode array. The correlation in the vertical direction is performed using a modified charge-coupled device (CCD) operating in the shift-and-add mode. A laser diode array, as opposed to an LED array used in previous systems, provides more power so that full use can be made of the dynamic range capabilities of the acoustoptic device and CCD. Key features of the system will be presented, including the random access template memory, the custom laser diode array consisting of 64 individually addressed laser diodes, and the custom optical design to achieve nearly diffraction-limited image quality and compactness. DOE

N90-30055# Lawrence Livermore National Lab., CA.
XMM SPACE TELESCOPE: DEVELOPMENT PLAN FOR THE LIGHTWEIGHT REPLICATED X RAY GRATINGS
R. C. Montesanti, D. P. Atkinson, D. F. Edwards, and J. L. Klingmann Jun. 1990 9 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract W-7405-eng-48)
(DE90-015620; UCRL-JC-104339; CONF-900756-27) Avail: NTIS HC A02/MF A01

An approach and development plan for the production of replicated variable line spacing x ray reflection gratings on lightweight substrates is described. The gratings will be arrayed in spectrometers to analyze the soft x rays gathered by the telescopes flown around the European Space Agency (ESA), X ray Multi-Mirror Mission (XMM). The mission requires about 750 gratings to form 3 arrays. Each array provides a grating area of approximately 5 square meters. From relatively few master gratings, the low blaze angle gratings will be replicated onto 55 gram substrates having an equivalent length/thickness aspect ratio (ge)40. We will describe the criteria used for selecting the substrate design and material. A multi-phased study to solve identified technical problems associated with the replication of these gratings is also described. We will report on the present status of the substrates and replication process. DOE

N90-30056# Lawrence Livermore National Lab., CA. Field Test Systems Div.
COMPARISON OF ELECTRO-OPTIC DIAGNOSTIC SYSTEMS
K. G. Hagans and P. D. Sargis 1990 8 p Presented at the SPIE 1990 International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE90-015619; UCRL-JC-104337; CONF-900756-28) Avail: NTIS HC A02/MF A01

We have examined the component devices used in electro-optic transient recording systems and studied their contributions to system noise levels. This work includes the investigation of three system configurations: a 1300-nm laser diode system, an 810-nm Mach-Zehnder system, and a 1300-nm hybrid system. As a result of our work, we have developed a method of analysis for determining the theoretical noise sources in electro-optic transient recording systems. DOE

N90-30057# Pacific Northwest Lab., Richland, WA.
PLANAR WAVEGUIDE SPECTROMETER
D. S. Goldman, P. L. White, and N. C. Anheier Jul. 1990 6 p Presented at the SPIE's International Symposium on Optical and Optoelectronic Applied Science and Engineering Exhibit, San Diego, CA, 8-13 Jul. 1990
(Contract DE-AC06-76RL-01830)
(DE90-016308; PNL-SA-18152; CONF-900756-36) Avail: NTIS HC A02/MF A01

An integrated optic consisting of buried diffraction gratings and a planar waveguide was developed as an internal reflectance element for broad-band spectroscopic analysis of liquids. Polystyrene or tantalum pentoxide waveguides were deposited over a pair of diffraction gratings etched into the surface of a glass slide. Multiwavelength light was focused through the substrate onto the first grating. Component wavelengths were coupled into the waveguide and spatially dispersed by the second grating after propagating through the waveguide. A silicon photodiode array detector was used to collect the spectra data. Our goal is to produce a compact, rapid spectrometer having no moving parts that can take advantage of fiber optics and fast array detectors in the visible and near-infrared regions for industrial process control. The thin planar waveguide provides enhanced sensitivity to analyze weaker absorptions in the near-infrared. DOE

N90-30058# Brookhaven National Lab., Upton, NY.
LIGHT SCATTERING FROM SURFACE AND SUB-SURFACE DEFECTS
E. L. Church (Army Armament Research and Development Command, Dover, NJ.) and P. Z. Takacs 1989 24 p Presented at the American Society for Precision Engineering Spring Conference, Tucson, AZ, 25-27 Apr. 1989
(Contract DE-AC02-76CH-00016)
(DE90-016311; BNL-44963; CONF-8904259-3) Avail: NTIS HC A03/MF A01

Light scattering is an important if unwanted effect of imperfect surface finish. It can also be used for locating, identifying and quantifying surface and subsurface defects. Similar problems have been studied for many years in the field of microwave remote sensing and much of the extensive literature in that field has direct application to the present optical problem. This paper illustrates this approach by considering two elementary applications: topographic scattering from metal surfaces, and subsurface and bulk scattering from weakly inhomogeneous transparent materials. This approach has been developed into a practical method for the quality control of high-performance mirrors, while possible applications to subsurface damage are limited by the lack of availability of controlled experimental data. DOE

N90-30059# Technische Hochschule, Darmstadt (Germany, F.R.). Fachbereich Physik.
IMAGE AMPLIFICATION IN PHOTOREACTIVE CRYSTALS AND UTILIZATION IN OPTICAL REACTION SYSTEMS Ph.D. Thesis [BILDVERSTAERKUNG IN PHOTOREFRAKTIVEN KRISTALLEN UND ANWENDUNG IN OPTISCHEN RUECKKOPPLUNGSSYSTEMEN]
Andreas F. W. Herden 1988 131 p In GERMAN
(ETN-90-97285) Avail: NTIS HC A07/MF A01

Because of the high electrooptic effect of BaTiO3 and the resulting diffusion-dominated charge transport, it is chosen as optical bidimensional amplifier for analogically optical image processing systems. The obtained image quality, the nonlinear behavior by pump wave damping, the coupling between image points and the direction dependance of the amplification could be

quantitatively reached. In a feedback system with amplification by two wave mixing, the coupling by the intensity-depending gain between two different channels with autooscillations was examined, as well as by four wave mixing by means of phase conjugation of spatial injection locking. The dependance of the auto oscillations on the intensity of the pump waves and the internal resonator losses could be calculated and experimentally proved. ESA

N90-30060# Osnabrueck Univ. (Germany, F.R.). Fachbereich Physik.
PHOTOINDUCED AND HOLOGRAPHICALLY REINFORCED LIGHT DIFFUSION IN ELECTROOPTIC CRYSTALS Ph.D. Thesis [PHOTOINDUZIERTE UND HOLOGRAPHISCH VERSTAERKTE LICHTSTREUUNG IN ELEKTROOPTISCHEN KRISTALLEN]
Joerg Marotz 1988 112 p In GERMAN
(ETN-90-97321) Avail: NTIS HC A06/MF A01

The light induced diffusion effects in photorefractive crystals, particularly LiNbO3:Fe are theoretically described by means of the dynamic holographic retroaction between primary waves and diffusion waves. The reaction of the ion-doped LiNbO3 crystal on an intensity sample was depicted by the Kukhtarev equations. The modulation of the donator and acceptor concentrations was taken into account. The photovoltaic current was described by assuming small transport lengths for the charge carriers. The dependence of the photovoltaic tensor on the donator concentration was linearly approximated. The resolution of the equations shows the dependence of the space charge field on the modulation of the intensity grid. ESA

N90-30061# Institut de Mecanique des Fluides de Lille (France).
DETERMINATION OF DENSITY USING SIMULTANEOUS INTERFEROMETRY METHODS [DETERMINATION DE CHAMP DE MASSE VOLUMIQUE PAR INTERFEROGRAMMES SIMULTANES]
J. M. Desse and J. C. Pegneaux 16 Mar. 1990 42 p In FRENCH
(Contract DRET-89-003-07)
(IMFL-90/04; ETN-90-97567) Avail: NTIS HC A03/MF A01

A new method based on the differential interferometry of light is described. The feasibility of the optical system obtaining two interferograms simultaneously is proved. The experimental device includes two optical interferometers and fast cameras. The results of the measurements of the flow density fields surrounding an obstacle are discussed. High quality images are obtained. The system improves automatic image analysis. ESA

N90-30062# Royal Signals and Radar Establishment, Malvern (England).
QUANTUM WELL INFRARED DETECTORS 1: SOME CALCULATIONS OF THEIR OPTICAL PROPERTIES
M. J. Kane Feb. 1990 27 p
(RSRE-Memo-4363; BR113883; ETN-90-97607) Copyright Avail: NTIS HC A03/MF A01

The quantum well infrared detector is a new kind of infrared photon detector that can be made to work in the wavelength range 5 to 20 microns. Some theoretical calculations which illustrate the mode of operation of this detector are described. The manner in which a quantum well system can be made into an infrared photoconductor is qualitatively described and optical processes in such a device are illustrated with some calculations of the properties of an idealized system. Some of the corrections necessary to give an accurate description of a real quantum well system are included and design rules necessary to give a detector with a specified threshold photon energy are presented. ESA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N90-30063# International Centre for Theoretical Physics, Trieste (Italy).
A REVIEW OF SELF GENERATED B-FIELD IN ICF CORONA
L. N. Jha (Tribhuvan Univ., Tripureswar, Nepal) Jul. 1989 21 p Presented at the International Workshop on Laser Plasma Interaction, India, Nov. - Dec. 1989 Sponsored in part by Swedish Agency for Research Cooperation with Developing Countries
(DE90-627479; IC-89/164) Avail: NTIS (US Sales Only) HC A03/MF A01

The self generated high order magnetic field in the corona of Inertial Confinement Fusion Plasma plays a very important role in the design of fusion target because of its strong influence on the transport of thermal flux from the critical density region to the ablation layer. A review of the generation of megagauss magnetic field both experimental, theoretical and simulation studies has been presented. DOE

N90-30064# Hampton Inst., VA. Dept. of Physics.
[STUDY OF A 1-Hz HYPOCYCLOIDAL PINCH (HCP) PUMP FOR PRODUCTION OF ULTRAVIOLET LASERS] Final Technical Report, Oct. 1986 - Dec. 1989
Demetrius D. Venable, Kwang S. Han, Ja H. Lee, J. K. Kim, and S. M. Lee 1 Apr. 1990 141 p
(Grant AF-AFOSR-0345-86; AF Proj. 3484)
(AD-A224091; AFOSR-90-0674TR) Avail: NTIS HC A07/MF A01 CSCL 09/3

A 1-Hz hypocycloidal pinch (HCP) pumped laser was operated at 1 kJ input energy. The time integrated continuum spectrum of the pump light approximated that of a 15,000 K blackbody for the wavelength range above 250 nm. The pump emission was found to be stable at 1 Hz operation. The overall efficiency of the system was found to be 0.01 percent for single shot operation of pumping blue-green and near ultraviolet (UV) dye lasers 2 MW, but the laser output saturated with the input energy 4 kJ due to thermal lensing effects in the dye. Thermal effects introduced by nonuniform heating of the dye solution resulted in a reduction of the UV laser output as repetition rates increased. The thermal effects were significantly reduced by using a double walled dye cuvette. A theoretical model was developed to describe the electromagnetic acceleration of the plasma produced in the HCP device. The computer model described the operation of the device in the snow-plow mode and took into account the unique geometry and electrical parameters of the HCP devices used in the laboratory. GRA

N90-30065# California Univ., Irvine. Dept. of Physics.
ANOMALOUS DECAY OF LANGMUIR TURBULENCE. HIGH POWER, HIGH FREQUENCY RADIATION FROM BEAM-PLASMA INTERAACTIONS Final Report, 15 Nov. 1987 - 29 Jun. 1990
Gregory Benford 28 Jun. 1990 19 p
(Grant AF-AFOSR-0217-87; AF Proj. 2301)
(AD-A224282; AFOSR-90-0761TR) Avail: NTIS HC A03/MF A01 CSCL 20/9

A new Stark effect diagnostic was used to measure the E-field distribution of Langmuir waves in beam-plasma turbulence. Abrupt beam cut off causes the distribution's amplitude to decay exponentially in a microsecond, in disagreement with recent power law scalings deduced from cascade theory. GRA

N90-30066# Chicago Univ., IL. Dept. of Chemistry.
EXPERIMENTAL STUDIES LEADING TO ENERGY STORAGE. SPECTROSCOPY AND DYNAMICS OF POLYATOMIC HYDROGEN IN LIQUID, SOLID AND GASEOUS HYDROGEN PLASMAS Final Summary Report, Aug. 1986 - Jul. 1989
Takeshi Oka Jun. 1990 32 p
(Contract F04611-86-K-0069)

(AD-A224343; AL-TR-90-019) Avail: NTIS HC A03/MF A01 CSCL 20/5

The infrared spectrum was observed of ionized solid hydrogen produced by high energy bombardment of electrons. The spectrum gave vibrational frequencies of H3+ and its hydrogen clusters in the solid. This has opened up a new method of ion spectroscopy in solids. Extremely sharp solid hydrogen spectral lines were observed in nearly pure para-solid hydrogen. This was the first time that an optical spectrum was observed with such high resolution and opened a new direction in condensed phase spectroscopy and the study of intermolecular interaction. GRA

N90-30067# Mission Research Corp., Albuquerque, NM.
BEAM AND PLASMA PHYSICS RESEARCH Final Report, Aug. 1986 - Mar. 1990
Robert F. Stellingwerf, Robert E. Peterkin, Jr., and Donald J. Sullivan Jun. 1990 125 p
(Contract F29601-86-C-0216; AF Proj. 5797)
(AD-A224452; MRC/ABQ-R-1281; WL-TR-90-29) Avail: NTIS HC A06/MF A01 CSCL 20/9

Analysis was performed in high power microwave computations and theory and high energy plasma computations and theory. The HPM computations concentrated on generation, sources and propagation. Major codes used were the particle-in-cell codes SOS and ISIS. Topics studied were sources and antennas, propagation, relativistic klystron amplifiers, virtual cathode oscillators, magnetically insulated transmission lines, transvertrons and vircator phase/frequency locking. High energy plasmas were analyzed with MACH2, an implicit continuous Eulerian, arbitrary Lagrangian-Eulerian nonideal magnetohydrodynamic code. MACH2 modelled a variety of high energy plasmas including plasma flow switches, imploding liners and plasmas, compact toroids, magnetic reconnection and plasma guns. A smooth particle hydrodynamics code was developed to model various conditions, including shock heating, explosions and implosions. An optical multichannel analyzer was also provided to analyze plasma emission line spectra. GRA

N90-30068# Japan Atomic Energy Research Inst., Tokyo.
TOKAMAK PLASMA SHAPE IDENTIFICATION WITH A LEGENDRE-FOURIER EXPANSION OF THE VACUUM POLOIDAL FLUX FUNCTION IN THE TOROIDAL COORDINATES
Kenichi Kurihara, Toyoaki Kimura, Minoru Takahashi, Youichi Kawamata, Shinya Sakata, and Hiromi Akasaka Feb. 1990 49 p
(DE90-508031; JAERI-M-90-001) Avail: NTIS (US Sales Only) HC A03

A new method is proposed for identification of the outermost magnetic surface of tokamak plasmas. The method is based on the analytical solution of the Grad-Shafranov equation in a vacuum region under the toroidal coordinates. This method is applicable to accurate feedback control and real-time visualization of various plasma configurations, and robust to the loss of sensors or the existence of signal noise. DOE

N90-30069# National Inst. for Fusion Science, Nagoya (Japan).
SYMMETRY AND ISLAND STRUCTURE OF THE STANDARD MAP
Y. Nomura, S. Y. Kim, T. Kamimura, and Y. H. Ichikawa Feb. 1990 44 p
(DE90-508076; NIFS-5) Avail: NTIS (US Sales Only) HC A03

Even though the primary interest is concerned with stochastic properties of the low dimensional nonlinear dynamical systems, identification of the fixed points and analysis of the periodic orbits are a necessary and unavoidable step in the studies of chaotic behavior. For the case of 2-D area preserving mapping, the symmetry properties of the map provides critical information on the island structure of the mappings. In order to illustrate usefulness of knowledge of the symmetry properties, the periodic orbits of the standard map are discussed in detail by constructing the families of symmetry curves. DOE

N90-30070# National Inst. for Fusion Science, Nagoya (Japan).
STOCHASTIC PROPERTIES OF THE PLASMA WAVE HEATING MAP
Y. Nomura, T. Kamimura, and Y. H. Ichikawa Feb. 1990 33 p
(DE90-508077; NIFS-6) Avail: NTIS (US Sales Only) HC A03

Diffusion coefficient for stochastic ion motion in a lower hybrid wave is derived analytically by use of the characteristic function method. The renormalization calculation is carried out successfully to account for effects of the higher order correlation. Numerical observation of the diffusion process confirms the expectation that the renormalized diffusion coefficient describes correctly the stochastic properties of the systems even in the region of the small stochastic parameter, except where the accelerator modes manifest their influence upon the chaotic orbits. DOE

N90-30071# National Inst. for Fusion Science, Nagoya (Japan).
THREE DIMENSIONAL STUDIES OF HELICAL EQUILIBRIA AND MAGNETIC SURFACE BREAKING DUE TO THE FINITE BETA EFFECT
Takaya Hayashi, Tetsuya Sato, and Akira Takei Feb. 1990 37 p
(DE90-508078; NIFS-7) Avail: NTIS (US Sales Only) HC A03

Three dimensional equilibrium and breaking of magnetic surfaces due to the finite beta effect in a l = 2 heliotron/torsatron configuration are studied by using a newly developed three-dimensional equilibrium code. The breaking is significantly suppressed as gamma(sub c) (pitch parameter) becomes smaller. An in-ward shift of the plasma by using the vertical field and elliptic (vertical) shaping using the quadrupole field can also suppress the breaking. DOE

N90-30072# National Inst. for Fusion Science, Nagoya (Japan).
A MODEL OF PEAKED DENSITY PROFILE AND INWARD PINCH IN TOKAMAKS
Sanae-I Itoh Feb. 1990 15 p
(DE90-508079; NIFS-8) Avail: NTIS (US Sales Only) HC A03

A model theory of peaked density profile and inward flux of ohmic discharges in tokamak is presented. Anomalous particle fluxes in the presence of radial electric field, E(sub r), and radial current are consistently solved in stationary state. Viscous damping of differential flow due to E(sub r) balances with particle diffusion, which determines density and E(sub r) structures. In viscous plasma, peaked profile is expected. Reduction of edge neutrals induces further inward flux; change of E(sub r) with ion viscous damping propagates into center, causing the ion heating as well. DOE

N90-30073# National Inst. for Fusion Science, Nagoya (Japan).
SPATIAL STRUCTURE OF PARTICLE-ORBIT LOSS REGIONS IN L=2 HELICAL SYSTEMS
H. Sanuki, J. Todoroki, and T. Kamimura Feb. 1990 25 p
(DE90-508080; NIFS-9) Avail: NTIS (US Sales Only) HC A03

Particle orbits and loss regions in both configuration and velocity space are studied on the basis of adiabatic invariants and guiding center drift equations. The boundary of loss region is determined from the condition whether the drift surfaces for both localized particles and transition particles between localized and blocked particles hit the limiter or not. Analytical form of loss region boundary for localized particle with V parallel = 0 is obtained. Effects of ripple modulation and electrostatic potential on particle confinement are also discussed. DOE

N90-30074# Bucharest Univ. (Romania).
TRANSFORMATION GROUP METHODS IN PLASMA PHYSICS Ph.D. Thesis [METODE ALE GRUPULUI DE TRANSFORMARI IN FIZICA PLASMEI]
Andrei Ludu 1989 22 p In ROMANIAN
(DE90-628755; INIS-mf-12604) Avail: NTIS (US Sales Only) HC A03/MF A01

Transformation groups methods using elements of differential geometry and algebraic topology are applied to the equations describing plasma physics. DOE

N90-30075# Sao Paulo Univ. (Brazil). Inst. de Fisica.
STRUCTURE OF MAGNETIC FIELD IN TOKAMAKS [ESTRUTURA DO CAMPO MAGNETICO EM TOKAMAK]
M. V. A. P. Heller and I. L. Caldas 1990 8 p In PORTUGESE
(DE90-628904; INIS-BR-2057; BR-9023199) Avail: NTIS (US Sales Only) HC A02/MF A01

Magnetic surfaces, necessary to plasma confinement, can be extinguished by resonant helical perturbations with small intensities due to plasma oscillations or external helical currents. The mapping of magnetic field is obtained integrating numerically the differential equation of its lines. Criteria which evaluate the chaotic distribution of lines between resonant magnetic islands are presented. DOE

N90-30076# Sao Paulo Univ. (Brazil). Inst. de Fisica.
MAGNETIC SURFACES IN TOKAMAKS [SUPERFICIES MAGNETICAS EM TOKAMAKS]
M. C. R. Andrade, S. J. Camargo, and I. L. Caldas 1990 7 p In PORTUGESE
(DE90-628905; INIS-BR-2058; BR-9023200) Avail: NTIS (US Sales Only) HC A02/MF A01

The behavior of magnetic surfaces necessary to plasma confinement is investigated. The description of magnetic field line equations in a tokamak with large aspect-ratio, is done by Hamiltonian formalism with angle-action variables. The system integrability which characterizes the existence of such surfaces, and which can be destroyed with perturbations in the resonant helical currents is verified. When it occurs, the problem is investigated by medium magnetic surfaces, analyzing the present magnetic islands. It is shown that the position of these islands varies according to the ratio between kinetic magnetic pressures of the plasma. DOE

N90-30077# California Univ., San Diego, La Jolla. Inst. of Pure and Applied Physical Sciences.
TRANSPORT OF NONNEUTRAL PLASMAS Annual Progress Report, Feb. 1989 - Feb. 1990
J. H. Malmberg, C. F. Driscoll, and T. M. ONeil Jun. 1990 15 p
(Contract N00014-89-J-1714)
(AD-A223457) Avail: NTIS HC A03/MF A01 CSCL 20/9

The research program includes both ongoing experiments and theory on transport in pure electron plasmas; and the design, construction and operation of a new pure ion plasma apparatus. Recent experiments on the electron apparatus have elucidated the transport and turbulence associated with diocotron instabilities and vortex structures, and have measured the vortex pairing instability in detail. Recent theory work has analyzed the newly observed diocotron instability, analyzed negative temperature 2D thermal equilibria, and investigated the crystalline equilibria of cold ion clusters. The characteristics of the new ion apparatus have been determined, the major components have been designed, and purchasing and construction is underway. GRA

N90-30078# Lawrence Livermore National Lab., CA.
A DISTRIBUTED CONTROL AND MONITOR SYSTEM USED IN LASER FUSION RESEARCH
B. A. Jones and N. J. Selchow Mar. 1990 11 p Presented at the International Conference and Exhibition of the Instrument Society of America, New Orleans, LA, 14-19 Oct. 1990 Revised
(Contract W-7405-eng-48)
(DE90-011483; UCRL-101945-Rev-1; CONF-901017-1-Rev-1)
Avail: NTIS HC A03/MF A01

Laser Fusion research experiments require very low pressure environments to properly diagnose the plasma physics phenomena occurring during laser fusion reactions. Target chambers with very large and complex pumping systems are required to achieve and maintain these extremely low pressures. This paper describes a recently installed distributed control and monitoring system that automates the operation of these pumping systems. Through automation, this system is providing an enhanced shot rate by reducing the manpower required to ready the system for a target shot while increasing the overall safety of the system. DOE

N90-30079# Lawrence Livermore National Lab., CA.
EXPERIMENTAL OBSERVATIONS OF NONLINEAR EFFECTS IN LASER-PLASMA INTERACTIONS
H. A. Baldis (National Research Council of Canada, Ottawa, Ontario) and P. E. Young 20 Jul. 1990 16 p Presented at the 1990 Summer Workshop on Nonlinear and Chaotic Phenomena in Plasmas, Solids, and Fluids, Edmonton, Ontario, 16-27 Jul. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE90-015195; UCRL-JC-104606; CONF-9007136-2) Avail: NTIS HC A03/MF A01

Understanding the growth and saturation of parametric instabilities in laser-produced plasmas requires knowledge of the nonlinear properties of the instabilities and their interaction with each other. Nonlinear behavior of parametric instabilities, which are usually associated with unique optical features, have been evidenced in numerous experiments on a variety of laser facilities. We will discuss four examples of nonlinear behavior in laser-produced plasmas: (1) nonlinear stimulated Brillouin scattering spectra, (2) suppression of stimulated Raman scattering by stimulated Brillouin scattering, (3) the parametric decay instability and the onset of turbulence, and (4) the transition to bursting behavior of the two-plasmon decay instability. We also discuss experiments that demonstrate the nonlinear propagation of laser light through a plasma and the nonlinear effects which occur as a consequence. DOE

N90-30080# Lodestar Research Corp., Boulder, CO.
FUNDAMENTAL STUDIES OF FUSION PLASMAS Annual Report, 1 Nov. 1987 - 30 Oct. 1990
R. E. Aamodt, P. J. Catto, D. A. Dippolito, J. R. Myra, and D. A. Russell Mar. 1990 22 p
(Contract DE-FG02-88ER-53263)
(DE90-015732; DOE/ER-53263/9; LRC-90-16) Avail: NTIS HC A03/MF A01

Areas of discussion are as follows: tokamak transport, auxiliary heating physics; ICRF impurity study; ponderomotive stabilization studies; ICRF induced fluxes in the edge plasma; runaway electron confinement in TEXT; RF sheath modelling for ICRF antenna Faraday screens; and isotropic energetic in fluxes in tokamaks. DOE

N90-30081# Lawrence Livermore National Lab., CA.
UCD-LLNL COLLABORATION ON BASIC PLASMA PHYSICS RESEARCH IN INERTIAL CONFINEMENT FUSION
Katsu Mizuno, J. S. DeGroot (California Univ., Davis.), Peter Young, Paul Drake, and K. Estabrook Jul. 1990 4 p
(Contract W-7405-eng-48)
(DE90-015771; UCRL-CR-104449) Avail: NTIS HC A01/MF A01

We have made extensive studies of the Ion Acoustic Decay Instability (IADI) in laser-produced plasmas using the Janus (Phoenix) laser. We found that the threshold is quite low and that, in planar plasmas, it can be reduced to homogeneous-plasma, collisional values. These observations are consistent with the plasma-density profiles calculated by hydrodynamic simulations using the LASNEX computer code run with a flux limiter of f = 0.1. We have designed experiments to study the IADI in larger plasmas using the Nova laser. DOE

N90-30082# State Univ. of New York, Buffalo. Dept. of Electrical and Computer Engineering.
SOFT X RAY CONTACT IMAGING OF BIOLOGICAL SPECIMENS USING A LASER-PRODUCED PLASMA AS AN X RAY SOURCE Final Report
P. C. Cheng 1990 15 p
(Contract DE-AS03-88DP-10782)
(DE90-016098; DOE/DP-10782/1) Avail: NTIS HC A03/MF A01

The use of a laser produced plasma as an x ray source provides significant advantages over other types of sources for x ray microradiography of, particularly, living biological specimens. The pulsed nature of the x rays enables imaging of the specimen in a

living state, and the small source size minimizes penumbral blurring. This makes it possible to make an exposure close to the source, thereby increasing the x ray intensity. The applications were demonstrated of the applications of x ray contact microradiography in structural and developmental botany such as the localization of silica deposition and the floral morphologenesis of maize. DOE

N90-30083# Mississippi State Univ., Mississippi State. Diagnostic Instrumentation and Analysis Lab.
DIAGNOSTIC DEVELOPMENT AND SUPPORT OF MHD TEST FACILITIES Technical Progress Report, Jul. - Sep. 1989
Oct. 1989 67 p
(Contract DE-AC02-80ET-15601)
(DE90-015403; DOE/ET-15601/38) Avail: NTIS HC A04/MF A01

The Diagnostic Instrumental and Analysis Laboratory (DIAL) is developing diagnostic instruments for MHD power train data acquisition and for support of MHD component development test facilities. Microprocessor-controlled optical instruments, initially developed for HRSR support, are being refined, and new systems to measure temperatures and gas-seed-slag stream characteristics are being developed. To further data acquisition and analysis capabilities, the diagnostic systems are being interfaced with DIAL's computers. Technical support for the diagnostic needs of the national MHD research effort is being provided. DIAL personnel will also cooperate with government agencies and private industries to improve the transformation of research and development results into processes, products and services applicable to their needs. Some tests were conducted at the Coal-Fired Flow Facility (CFFF) at UTSI, and the Component Development and Integration Facility (CDIF), Butte, Montana. DOE

N90-30084# Illinois Univ., Chicago.
CONTROL OF HELIUM ACCUMULATION
V. Varadarajan and G. H. Miley 1990 18 p Presented at the Innovative Technologies for Impurity Control Workshop, Princeton, NJ, 11-12 Jan. 1990
(Contract DE-FG02-86ER-52127)
(DE90-015658; DOE/ER-52127/70; CONF-900170-2) Avail: NTIS HC A03/MF A01

The fishbone like oscillations in ignited tokamaks are addressed in an exploratory manner. The effects of the strong m = 1 oscillations and the weak high frequency oscillations are examined in order to explore the feasibility of utilizing these oscillations for alpha accumulation control. The prospects of achieving small scale continuous alpha removal from the plasma center by mild fishbone-like oscillations are examined. DOE

N90-30085# Illinois Univ., Urbana. Fusion Studies Lab.
OVERVIEW OF ADVANCED FUEL FUSION
George H. Miley 1989 27 p Presented at the Workshop on Tritium and Advanced Fuels in Fusion Reactors, Varenna, Italy, 6-15 Sep. 1989
(Contract DE-FG02-86ER-52127)
(DE90-015660; DOE/ER-52127/67; CONF-8909101-1) Avail: NTIS HC A03/MF A01

The status and issues related to the development of advanced fuel fusion are discussed. D-(sup 3)He is a key advanced fuel since it has the potential of igniting in a variety of confinement concepts. However, to obtain a plentiful source of (sup 3)He, either lunar mining or breeding becomes necessary. Highly non-Maxwellian plasmas, such as might occur in beam-beam fusion concepts, are necessary to address fuels like p-(sup 11)B which have the added advantages of a more aneutronic character and plentiful fuel supply. Such plasmas appear very difficult to achieve but several possible approaches such as electrostatic confinement are noted. DOE

N90-30086# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
LECTURES IN PLASMA DIAGNOSTICS
I. H. Hutchinson Jun. 1990 59 p Presented at the 4th Latin American Workshop on Plasma Physics, Buenos Aires, Argentina, 16-27 Jul. 1990
(Contract DE-AC02-78ET-51013)
(DE90-015825; DOE/ET-51013/283; CONF-900739-2; PFC/CP-90-1) Avail: NTIS HC A04/MF A01

This paper discusses the following topics on plasma diagnostics: Electric probes in flowing and magnetized plasmas; Electron cyclotron emission absorption; Magnetic diagnostics; Spectroscopy; and Thomson Scattering. DOE

N90-30087# Washington Univ., Seattle. Aerospace and Energetics Research Program.
COMPACT TOROID RESEARCH Progress Report, Aug. 1988 - Aug. 1989
George C. Vlases 25 Aug. 1989 30 p
(Contract DE-FG06-87ER-53243)
(DE90-016123; DOE/ER-53243/3; UWAERP-21; DOE-3) Avail: NTIS HC A03/MF A01

During the period from August 1988 to August 1989, the Coaxial Slow Source (CSS) project has made progress in three areas: The Coaxial Slow Source Upgrade CSSU version of the device was operated until January of 1989. In the Fall of 1988 Langmuir probes were installed to measure the end losses, the Thomson scattering system was made more sensitive, and a more detailed scan with internal magnetic probes was performed. Since then, the CSSU-centered work has concentrated on refining the analysis and interpretation of data. The CSS device was rebuilt as CSSP in the period Jan. to June 1989, and began operation on July 3, 1989. Simultaneously, a new data acquisition and processing system based on a VAX 3200 workstation and MDS and IDL software was developed. The COAX 2 code was significantly improved by the treatment of hydrogen ionization, including the radiative loss terms, and the inclusion of a more consistent transport and impurity radiation package. The improved code was used both to interpret the results of the CSSU experiments, and to predict performance for the CSSP and CSS2 devices. Details of these three areas of progress are given in the following sections. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N90-30088 Northwestern Univ., Evanston, IL.
INVESTIGATION OF YBa2Cu3O(7-SIGMA) BY NMR AND CONSTRUCTION OF AN ULTRA LOW TEMPERATURE CRYOSTAT Ph.D. Thesis
Michael Newman Lovellette 1989 259 p
Avail: Univ. Microfilms Order No. DA8913994

The investigation by Cu-63 NMR and NQR is reported on the high temperature superconductor YBa2Cu3O7. The decay of the magnetization observed following an inversion of the Cu spin system is found to be nonexponential. The spin-lattice relaxation rate observed by NMR is not affected by the onset of superconductivity, and throughout the temperature range of 5 to 150 K is only weakly temperature dependent. However, the NQR spin-lattice relaxation rate drops dramatically with decreasing temperature in the superconducting state. This suggests that different relaxation mechanisms are functioning in zero field as observed by NQR and high field as observed by NMR. The NMR spin-lattice relaxation can be explained by the presence of a dilute fluctuating spin system which orders at a temperature of approximately 1 K. The concentration of spins found by NMR techniques, 0.67 + or - 0.25 x 10(exp 21) spins/cu cm is in good agreement with the concentration determined by dc susceptibility measurements. The design and construction of a cryostat to conduct high resolution NMR measurements on He-3-B is described. In order to take full advantage of a high magnetic field homogeneity magnet for NMR a Pomeranchuk cooling system was constructed with a separate experimental cell to allow investigations at pressures other than the melting pressure. This system included

the Pomeranchuk cell, NMR cell, melting curve thermometers, heat switches, and associated support equipment. Although the Pomeranchuk cell was able to cool an external thermometer to below 2.5 mK the high starting temperature coupled with the high heat leak in the cryostat prevented work in the superfluid. A PrNi5 adiabatic nuclear demagnetization stage was constructed to precool the Pomeranchuk cell. There were also difficulties with this stage and it is continuing to undergo modification to improve its performance. Dissert. Abstr.

N90-30089# National Inst. of Standards and Technology, Gaithersburg, MD. Center for Computing and Applied Mathematics.

EFFECT OF A CRYSTAL-MELT INTERFACE ON TAYLOR-VORTEX FLOW WITH BUOYANCY

G. B. McFadden, B. T. Murray, S. R. Coriell, M. E. Glicksman, and M. E. Selleck Jul. 1990 19 p Prepared in cooperation with Rensselaer Polytechnic Inst., Troy, NY
(PB90-244401; NISTIR-4364) Avail: NTIS HC A03/MF A01 CSCL 20L

During crystal growth from the liquid, a fundamental problem is to understand the interaction of the crystal-melt interface with fluid flow in the liquid. This problem combines the complexities of the Navier-Stokes equations for fluid flow in the liquid with the nonlinear behavior of the free boundary representing the crystal-melt interface. Some progress has been made by studying explicit flows that allow a base state corresponding to a one-dimensional crystal-melt interface with solute and/or temperature fields that depend only on the distance from the interface. This allows the strength of the interaction between the flow and the interface to be assessed by a linear stability analysis of the simple base state. The case of a Taylor-Couette flow interacting with a cylindrical crystalline interface is currently being investigated both experimentally and theoretically. The authors consider the changes in the linear stability of this system produced by density-driven convection generated by the interaction of the density gradients with the gravitational and centripetal acceleration. Author

N90-30090# International Centre for Theoretical Physics, Trieste (Italy).

NEW REAL SPACE CORRELATED-BASIS-FUNCTIONS APPROACH FOR THE ELECTRON CORRELATIONS OF THE SEMICONDUCTOR INVERSION LAYER

Wei-Guo Feng, Wei-Wang Hong, and Xiang Wu (Academia Sinica, Beijing, China) Dec. 1989 9 p Sponsored in part by Chinese National Advanced Technology Foundation
(DE90-627315; IC-89/400) Avail: NTIS (US Sales Only) HC A02/MF A01

Based on the real space Correlated-Basis-Functions theory and the collective oscillation behavior of the electron gas with effective Coulomb interaction, the many body wave function is obtained for the quasi-two-dimensional electron system in the semiconductor inversion layer. The pair-correlation function and the correlation energy of the system have been calculated by the integro-differential method in this paper. The comparison with the other previous theoretical results is also made. The new theoretical approach and its numerical results show that the pair-correlation functions are definitely positive and satisfy the normalization condition. DOE

N90-30091# International Centre for Theoretical Physics, Trieste (Italy).

EFFECT OF RETARDATION ON THE REFLECTANCE PROPERTIES OF THE METALLIC FIBONACCI QUASI-SUPERLATTICE

Wei-Guo Feng, He-Sheng Yao, and Xiang Wu (Academia Sinica, Beijing, China) Dec. 1989 14 p Sponsored in part by Chinese National Advanced Technology Foundation
(DE90-627316; IC-89/401) Avail: NTIS (US Sales Only) HC A03/MF A01

Based on the hydrodynamic model theory and the transfer matrix method, we have re-examined the reflection properties by taking account of the retardation effect to the system of the metallic Fibonacci quasi-superlattice. For the normal incident S-polarized Soft X rays and extreme ultraviolet, we find that the self-similar reflecting spectrum will be restrained with the increasing of the retardation, but for the higher frequency region or at the smaller grazing angle, the self similarity will still exist for the lower generation quasi-superlattice. DOE

N90-30092# International Centre for Theoretical Physics, Trieste (Italy).

SURFACE PHOTOVOLTAGE SPECTROSCOPY OF REAL n-TYPE GaAs(110) SURFACES

M. S. El-Dessouki, S. B. El-Guiziri, and F. Z. Gobrial (Cairo Univ., Giza, Egypt) Oct. 1989 19 p Submitted for publication
(DE90-627325; IC-89/317) Avail: NTIS (US Sales Only) HC A03/MF A01

N-type GaAs single crystals cut parallel to the (110) plane and doped with phosphorus by ion beam implantation were used in the present study. Temperature dependence of the bulk electrical conductivity showed two distinct activated regions with activation energies Et sub 1 =0.75 + or - 0.04eV, and Et sub 2 =0.12 + or - 0.04eV. The first activation energy is probably that of deep phosphorous impurities, while the second was related to long range disorder in the sample near room temperature. Surface photovoltage studies at room temperature were carried out at atmospheric pressure and in vacuum for etched and unetched samples. For n-type GaAs etched surface, the experimentally observed surface states were not found to change their positions by changing the pressure. But in the case of etched samples the surface states showed some redistribution under vacuum. The time constants for the initial rise and fall of CPD by illumination and after switching it off, tau sub 1 and tau sub 2, respectively, were found to depend on the illumination intensity and photon energy. Their values range between 4 and 15 s. DOE

N90-30093# Arizona State Univ., Tempe.

THEORY OF ELECTRONIC STATES AND FORMATIONS ENERGIES OF DEFECT COMPLEXES, INTERSTITIAL DEFECTS, AND CRYSTAL GROWTH IN SEMICONDUCTORS Annual Report, Oct. 1988 - Oct. 1989

O. F. Sankey Oct. 1989 25 p
(Contract N00014-85-K-0442)
(AD-A224069) Avail: NTIS HC A03/MF A01 CSCL 20/5

The first version of an ab-initio molecular dynamics computer code can simulate the motion of atoms at a surface and in the bulk of a semiconductor. Newton's equation for the nuclei, F = ma is combined with the Schrodinger equation for the electrons, HPsi=EPsi, to obtain a uniform picture of a covalent system dynamical properties. Some of the performed simulations are listed. A tight-binding method is developed with tight binding matrix elements calculated entirely from first principles. No fitting to experiment of any quantities is needed or done. This tight binding Hamiltonian will calculate the electronic structure of the material. The electronic structure theory is based on the local density approximation (LDA), with no adjustable parameters. The use of approximations is essential to having a method which is fast enough to be useful for simulation of medium and large size systems. Where possible, the results are compared to experimental data and find agreement consistent with the LDA. GRA

N90-30094# Wisconsin Univ., Madison.

MICROSCOPIC ASPECTS OF THE INITIAL STAGES OF EPITAXIAL GROWTH. A SCANNING TUNNELING MICROSCOPY STUDY

M. G. Lagally, Y. W. Mo, R. Kariotis, B. S. Swartzentruber, and M. B. Webb 1 Apr. 1990 26 p
(Contract N00014-90-J-1119)
(AD-A224325; TR-4) Avail: NTIS HC A03/MF A01 CSCL 07/4

Scanning tunneling microscopy offers the opportunity to investigate growth and ordering processes at the atomic level and hence to identify and distinguish different kinetic and energetic mechanisms that may be operative. A review of the fundamental

mechanisms of growth is given. Scanning tunneling microscopy measurements of the ordering and growth of Si on (001) are used to illustrate these mechanisms. Diffusion coefficients, growth anisotropy and lateral accommodation coefficients, equilibrium island shapes and free energies, edge desorption energies, and diffusional anisotropy are discussed. GRA

N90-30095# Stanford Univ., CA.
SCANNING TUNNELING MICROSCOPY OF SEMICONDUCTOR SURFACES Final Report, 1 Apr. 1987 - 30 Sep. 1989
C. F. Quate and J. Nogami May 1990 12 p
(Contract N00014-87-K-0679)
(AD-A223339; SU-GL-4694) Avail: NTIS HC A03/MF A01 CSCL 09/1

Results are summarized from a program aimed at studying the atomic structure of semiconductor surfaces using scanning tunneling microscopy (STM). The bulk of the research concerned the epitaxial growth of metals on the (111) and the (100) surfaces of silicon, with particular emphasis on the metals indium and gallium. The STM images provided structural information on all of the metal-induced surface reconstructions in these systems as well as information on the general behavior of the metals on the Si surface, yielding insight into metal mobility, the effect of stepped substrates, and the nucleation of metal growth on the surface. In addition to the semiconductor surface work, there was some studies of the epitaxial growth of metals on Au(111), and the surface structure of the high temperature superconductor Bi2Sr2CaCu-2O8+8.

N90-30096# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
NONLINEAR OPTICAL STUDIES OF THE OPTICAL AND ELECTRONIC PROPERTIES OF SEMICONDUCTOR HETEROSTRUCTURES Final Report, 1 Sep. 1985 - 31 Dec. 1989
Duncan G. Steel 14 May 1990 95 p
(Grant AF-AFOSR-0280-85; AF Proj. 2301)
(AD-A223408; AFOSR-90-0673TR) Avail: NTIS HC A05/MF A01 CSCL 20/12

Experimental work emphasized demonstrating the use of high resolution frequency domain nonlinear laser spectroscopy for the study of materials, particularly semiconductor heterostructures. The work demonstrated that CW four-wave mixing spectroscopy provides new information regarding the origin of the nonlinear optical response in semiconductor materials as well as new information about structure and relaxation. Current progress is summarized: (1) First experimental observation of an interference effect in the nonlinear optical response in GaAs quantum well structures corresponding to a slow component in the nonlinear optical response shows that the interference effect is evidence that the exciton resonance frequency is shifted in the presence of the electron hole plasma produced by the ionized exciton; (2) Demonstration of frequency domain nonlinear optical spectroscopy methods for the direct measurement of the ambipolar diffusion coefficient and the electron-hole recombination rate in GaAs quantum well structures; (3) Measurement of the response time in strained quantum well structures where the heavy and light hole exciton overlap in energy; and (4) Use of precision nonlinear optical spectroscopy methods for the study of phonon induced spectral diffusion of the heavy hole exciton at low temperature in GaAs quantum well structures. GRA

N90-30097# Northeast Semiconductor, Inc., Ithaca, NY.
HIGH THROUGHPUT MBE MATERIALS FOR MODFET'S Final Report, 22 Aug. 1989 - 14 Feb. 1990
C. E. C. Wood Apr. 1990 8 p
(Contract DAAL03-89-C-0022)
(AD-A223452; ARO-27319.1-EL-SBI) Avail: NTIS HC A02/MF A01 CSCL 13/8

It has been shown that the preferred technique for the growth of MODFET material is by MBE, since competing technologies have been unable to demonstrate a reproducible technique for the growth of these devices. However, MBE as a production technique has two major drawbacks: the capital investment is high, and the growth is slow. A new approach to the problem of increasing MBE throughput and reducing wafer cost is to use existing MBE systems to grow the same high quality material as is currently grown, but at a much faster pace. This required only a small modification of the beam source. Research results have demonstrated that MODFET material can be grown at growth rates up to five times those currently used, with no degradation in electrical performance. This translates directly into cost savings for wafers grown. GRA

N90-30098# David Taylor Research Center, Bethesda, MD. Dept. of Ship Materials Engineering.
SYNTHESIS AND PROPERTY EVALUATION OF Y-Ba2-Cu3-O(6+x) SUPERCONDUCTORS Interim Report, Oct. 1988 - Sep. 1989
A. S. Rao and O. P. Arora Jun. 1990 28 p
(AD-A223494; DTRC-SME-89/100) Avail: NTIS HC A03/MF A01 CSCL 09/3

Superconducting YBa2Cu3O(6+x) powders were synthesized for obtaining fine particles of uniform size using solid state chemical reaction, coprecipitation and copper oxide coating with yttrium and barium oxalate or carbonate methods. The powders obtained from all three different routes showed superconductivity; however, the Tc values for the as synthesized powders via. the solid state and copper oxide coating methods were 90 K and the oxalate and carbonate derived powders was 80 and 60 K respectively. Recalcination and annealing the samples in oxygen had very little effect on the Tc value, but the sample resistance above Tc appears to decrease slightly. GRA

N90-30099# Naval Research Lab., Washington, DC. Dynamics of Solids Branch.
SOFT X RAY EMISSION SPECTRA FROM LASER-IRRADIATED HIGH-Z TARGETS Memorandum Report
G. Mehlman, P. G. Burkhalter, D. A. Newman, and B. H. Ripin (Sachs/Freeman Associates, Inc., Landover, MD.) 29 Jun. 1990 27 p Sponsored by DNA, Washington, DC
(AD-A223552; NRL-MR-6674) Avail: NTIS HC A03/MF A01 CSCL 20/5

X ray data were acquired from mass-limited targets with the Pharos III laser system. Targets, mounted at the tip of thin glass stalks, were microscopic pieces of single or multiple high-Z element composition. The laser irradiance was 4 x 10(exp 14) W/sq cm with about 300J of focused 1.05 microns wavelength laser beam. A convex KAP crystal spectrograph was used for its capability to collect high resolution spectra in the 4 to 20 A soft x ray region. The recorded spectral film densities were microdensitometered and converted by computer-processing to absolute continuum and emission line intensities. The spectral features were identified with the aid of ab-initio atomic structure calculations. The continuum background was evaluated as a source of pseudo-continua for absorption studies of soft x rays. GRA

N90-30100# GEC Hirst Research Centre, Wembley (England).
INTEGRATED TECHNOLOGY IN MCT/GaAs AND MCT/Si FOR MEDIUM AND LONG WAVELENGTH INFRARED Final Technical Report, 1 Mar. 1988 - 31 Jan. 1990
L. M. Smith, D. Patel, C. F. Byrne, P. Knowles, and G. T. Jenkin 1 May 1990 54 p
(Contract F49620-88-C-0059)
(AD-A223557; EOARD-TR-90-06) Avail: NTIS HC A04/MF A01 CSCL 20/12

MCT layers were grown by MOCVD on CdTe, GaAs and GaAs/Si for device processing. Both (111) and (100)MCT were grown on GaAs and the relative merits of the two orientations are discussed. The effects of the substrate preparation, pre-bake, nucleation and buffer growth conditions led to (100)MCT layers being p-type as grown with FWHM's of 80 to 90 arc seconds. CdTe was grown on (311)A and B GaAs. The CdTe adopts one of several orientations (100) or 3 to 4 DEG (311) and is untwinned with a relatively smooth surface morphology. Continuing studies of CdTe growth on Si indicate that the nucleation temperature

should be higher than 450 C. Annealing studies were carried out to establish material of a consistent p-type carrier concentration for processing, and to understand the diffusion mechanism within the material. A reproducible p-type anneal was established. Linear arrays of LWIR and MWIR diodes were n formed in MCT/GaAs by diffusion through a ZnS mask. 77K R sub o A products obtained over a range of cut-off wavelengths are comparable to the state-of-the-art literature values. R sub o A's of 10 ohm cm sq were obtained for arrays with a 11 micron cutoff. GRA

N90-30101# Purdue Univ., West Lafayette, IN. School of Electrical Engineering.
THE II-VI SEMICONDUCTOR SUPERLATTICES Final Technical Report, 1 Jul. 1985 - 30 Jun. 1989
Robert L. Gunshor and Nobuo Otsuka 17 Apr. 1990 16 p
(Grant AF-AFOSR-0185-85; AF Proj. 2306)
(AD-A223748; AFOSR-90-0718TR) Avail: NTIS HC A03/MF A01 CSCL 20/12

ZnSe was doped with Ga to electron concentrations in the low 10(exp 17)/cc. range. It was determined that optimum doping occurred for a Se:Zn flux ratio of close to unity as measured with a quartz crystal monitor. DLTS measurements indicated that delta doped samples had an order of magnitude less deep level traps than uniformly doped samples. Monte Carlo simulations of the growth kinetics of ZnSe, combined with absolute flux measurements, provided information about sticking coefficients and insight into stoichiometric growth conditions. The nucleation of epitaxial ZnSe on epitaxial GaAs was studied for the first time. MISFET devices were fabricated, and MIS capacitor C-V characteristics were used to evaluate the properties of the heterovalent interface Techniques were found by which interface state densities were reduced to values comparable to (Al,Ga)As. GRA

N90-30102# Lawrence Livermore National Lab., CA.
FIRST PRINCIPLES CALCULATION OF OXYGEN ORDERING IN YBa2Cu3O(7-y)
P. A. Sterne and L. T. Wille (Florida Atlantic Univ., Boca Raton.) 17 Apr. 1990 8 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contracts W-7405-eng-48; MDA972-88-J-1006)
(DE90-015205; UCRL-102335; CONF-900466-76) Avail: NTIS HC A02/MF A01

We have performed a number of first principles electronic structure calculations for YBa2, Cu3, O sub 7-y with different oxygen orderings and concentrations. The resulting total energies have been used to assess the applicability of some of the proposed models for oxygen ordering in this system. We find that the results are consistent with an Ising-like model with asymmetric next-neighbor interactions between oxygen sites. We determine effective interaction parameters from the first principles calculations and use them to compute the phase diagram for the system, which is in excellent agreement with experiment. DOE

N90-30103# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
TRANSMISSION ELECTRON MICROSCOPY STUDY OF ICB Al ON Ge AND Si(001) SUBSTRATES
U. Dehmen and K. H. Westmacott Apr. 1990 21 p Presented at the ISIAT 1990, Tokyo, Japan, 4-8 Jun. 1990 Submitted for publication
(Contract DE-AC03-76SF-00098)
(DE90-015299; LBL-29034; CONF-9006255-1) Avail: NTIS HC A03/MF A01

Ionized Cluster Beam (ICB) deposition is a novel technique for the production of thin films with interesting and unusual structures and properties. Its development effort has been spearheaded at Kyoto University, but interest in the technique has become widespread in recent years. At Berkeley, research is underway to characterize and understand the structure of interfaces in such films. Transmission electron microscopy (TEM) is being employed to obtain images of the atomic structure and the defects typical for these materials with the aim of understanding the relationship between deposition conditions and the structural characteristics of such interfaces. A question of fundamental importance in the formation of high-quality films is how the crystal structures of the substrate and the overlayer affect the epitaxial orientation relationship between them. In this study we present a comparison between Al films grown on two different substrates: (001) Si and (001) Ge. The interface structures are characterized in plan view by conventional microscopy using diffraction and moire contrast and in cross section by high resolution microscopy. Thin films of Al grown on (001) Si are found to be distinctly different from Al films grown on (001) Ge substrates. The relationship between interfaces produced by precipitation reactions in Al--Si and Al--Ge alloys. DOE

N90-30104# Pacific Northwest Lab., Richland, WA.
ADVANCED MATERIALS AND ELECTROCHEMICAL PROCESSES IN HIGH-TEMPERATURE SOLID ELECTROLYTES
J. L. Bates, L. A. Chick, G. E. Youngblood, and W. J. Weber Nov. 1989 30 p Submitted for publication
(Contract DE-AC06-76RL-01830)
(DE90-015552; PNL-SA-17577) Avail: NTIS HC A03/MF A01

The purpose of this research and development effort is to: (1) identify, develop, and demonstrate advanced materials for use as alternative electrodes, current interconnections and electrolytes in high-temperature solid-electrolyte electrochemical cells, and (2) develop an understanding of the synergistic effects of materials properties, structures and compositions on electrochemical processes in high-temperature solid electrolyte electrochemical cells. Materials evaluated (anodes) include oxides of Y, Zr, and Ce; materials evaluated as interconnects include La(sub x)Sr(sub x)CrO(sub 3) and La(sub x)Sr(sub x)Al(sub x)O(sub 3). DOE

N90-30105# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
HIGH RESOLUTION TRANSMISSION ELECTRON MICROSCOPY OF ALUMINOPHOSPHATES
Judith G. Ulan, Ron Gronsky, Rosemarie Szostak, and Kristin Sorby (Oslo Univ., Norway) Apr. 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract DE-AC03-76SF-00098)
(DE90-015632; LBL-29036; CONF-900466-75) Avail: NTIS HC A02/MF A01

VPI-5 transforms to AlPO(sub 4)-8 under mild thermal treatment (100 C, 18 hrs). High resolution transmission electron microscopy (HRTEM) micrographs, oriented normal to the c axis, show extensive defect-free regions in VPI-5, while slip planes normal to the c axis are found in AlPO(sub 4)-8. Analysis of the HRTEM data, in conjunction with infrared and thermal analysis, adsorption studies and x-ray powder diffraction, has lead to a proposed structure for AlPO(sub 4)-8. Though the sheets containing the 18 member rings which define the pores in VPI-5 remain intact in AlPO(sub 4)-8, reduction in the porosity is attributed to blockages created by the movement of these sheets relative to each other. DOE

N90-30106# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
SUBPICOSECOND RAMAN STUDY OF HOT ELECTRONS AND HOT PHONONS IN GaAs
Dai-Sik Kim and Peter Y. Yu Mar. 1990 12 p Presented at the NATO Advanced Workshop on Light Scattering in Semiconductors and Microstructures, Quebec, 5-9 Mar. 1990
(Contract DE-AC03-76SF-00098)
(DE90-015634; LBL-29174; CONF-9003190-1) Avail: NTIS HC A03/MF A01

In this paper we will describe in detail the use of Raman scattering with subpicosecond laser pulses for investigating both the Frohlich interactions between electrons and longitudinal optical (LO) phonons and the intervalley electron-phonon interactions. DOE

N90-30107# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Sciences Div.
STUDY OF HOT CARRIER RELAXATION IN QUANTUM WELLS BY SUBPICOSECOND RAMAN SCATTERING
Dai-Sik Kim and Peter Y. Yu Mar. 1990 9 p Presented at the 3d Ultrafast Laser Probe Phenomena in Bulk and Microstructure Semiconductors, San Diego, CA, 18-19 Mar. 1990 Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE90-015635; LBL-29175; CONF-9003189-1) Avail: NTIS HC A02/MF A01

Relaxation of hot carriers excited by subpicosecond laser pulses has been studied by Raman scattering in GaAs/AlAs multiple quantum wells with well widths varying between 100 and 1000 Angstrom. The hot phonon population observed by Raman scattering is found to decrease with the well width despite the fact that the hot electron temperature remains constant. The results are explained in terms of confinement of both electrons and optical phonons in quantum wells. DOE

N90-30108# California Univ., Berkeley. Lawrence Berkeley Lab. National Center for Electron Microscopy.
HIGH RESOLUTION TRANSMISSION ELECTRON MICROSCOPY OF PARTIAL STATES OF OXYGEN ORDER IN YBa2Cu3O(z)
C. P. Burmester, S. Quong, R. Gronsky, L. T. Wille, B. T. Ahn, V. Y. Lee, R. Beyers, T. M. Guer, and R. A. Huggins (Stanford Univ., CA.) May 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990 Prepared in cooperation with California Univ., Berkeley Sponsored in part by Cray Research, Inc.
(Contracts DE-AC03-76SF-00098; MDA972-88-J-1006)
(DE90-015637; LBL-29215; CONF-900466-77) Avail: NTIS HC A02/MF A01

High resolution electron microscopy (HREM) is used to investigate the effect of electron irradiation induced oxygen loss on the states of partial order in YBa2, Cu3, O sub z. Contrast effects visible in the (001) zone image as a result of the degree of the out-of-plane correlation of these ordered states are investigated. Using statistical simulations to aid in the analysis of the HREM images, an interpretation based on a kinetically limited evolution of the variation of long range (001) ordering is proposed. DOE

N90-30109# Argonne National Lab., IL. Materials and Components Technology Div.
PRACTICAL SUPERCONDUCTOR DEVELOPMENT FOR ELECTRICAL POWER APPLICATIONS Semiannual Report, Oct. 1989 - Jun. 1990
Kenneth C. Goretta, comp. Jun. 1990 24 p
(Contract W-31-109-eng-38)
(DE90-014836; ANL-90/25) Avail: NTIS HC A03/MF A01

Development of useful high-critical-temperature (high-(Tc)) superconductors requires synthesis of superconducting compounds; fabrication of wires, tapes, and films from these compounds; production of composite structures that incorporate stabilizers or insulators; and design and testing of efficient components. This report describes technical progress of research and development efforts aimed at producing superconducting components based on the Y--Ba--Cu, Bi--Sr--Ca--Cu, and Tl--Ba--Ca--Cu oxide systems. Topics discussed are synthesis and heat treatment of high-(Tc) superconductors; formation of monolithic and composite wires and tapes; investigation of superconductor/metal connectors; characterization of structures and superconducting and mechanical properties; and fabrication and properties of thin films. Collaboration with industry and academia is also documented. DOE

N90-30110# Oak Ridge National Lab., TN. Solid State Theory Section.
SUPERCONDUCTIVITY AND INFORMATION EXCHANGE Foreign Trip Report
R. A. Klemm Aug. 1990 13 p
(Contract DE-AC05-84OR-21400)
(DE90-015767; ORNL/FTR-3698) Avail: NTIS HC A03/MF A01

The author was invited to visit several institutions in Europe for the purposes of collaboration, information exchange, and presentation of seminars. Extensive exchanges of information regarding the current state of the field in high-temperature superconductivity took place. Five seminars on the recent work of Klemm and Liu on interlayer pairing were given, and the response was very favorable. A new collaboration on the role of gap anisotropy on the physical properties of high-temperature superconductors was begun. DOE

N90-30111# Lawrence Livermore National Lab., CA. Chemistry and Materials Science Dept.
A COMPARATIVE FIRST PRINCIPLES STUDY OF PHASE STABILITY IN Ni-Ti AND Ni-Al ALLOYS AROUND EQUIATOMIC COMPOSITION
P. E. A. Turchi, M. Sluiter, F. J. Pinski, and D. D. Johnson (Sandia National Labs., Albuquerque, NM.) 1 Aug. 1990 6 p Presented at the Spring Meeting of the Materials Research Society, San Francisco, CA, 16-21 Apr. 1990
(Contract W-7405-eng-48)
(DE90-016477; UCRL-102337; CONF-900466-81) Avail: NTIS HC A02/MF A01

Electronic structure and phase stability properties of Ni-Ti and Ni-Al around equiatomic composition are investigated with a first principles approach. The study is based upon the generalized purturbation method applied to the Korringa-Kohn-Rostoker multiple scattering formulation of the coherent potential approximation. Within this framework, effective cluster interactions which build up the configuration-dependent part of the internal energy are calculated. The strength of ordering tendencies in both bcc-based substitutional alloys is compared and contrasted in terms of hybridization effects, in relation with experimental evidences. DOE

N90-30112# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
OPTICAL NONLINEARITY DUE TO STRUCTURE DEFECTS AND BISTABILITY IN THE BAND DISCONTINUITY AREA OF CdS Ph.D. Thesis [STOERSTELLENKORRELLIERTE OPTISCHE NICHTLINEARITAET UND BISTABILITAET IM BANDKANTENNAHEN BEREICH VON CDS]
Thomas Hoenig 1989 237 p In GERMAN
(ETN-90-97303) Avail: NTIS HC A11/MF A02

The transmission properties of CdS in the band discontinuity is evaluated with the sharp absorption structures of excitonic excitation states and by a broadband defect-correlated absorption. A broadband induced transmission could be observed with increasing excitation density. The phenomenon was discussed in a model of increasing neutralization of ionized acceptors and immediate retroaction of the free charge carriers with photonic polaritons. It is shown that the bleaching of defect correlated absorption can cause contrasted transmittive optical bistability. The necessary reaction for a bistability was given by the reflection at the crystal surface. By resonant irradiation of the laser in the absorption of the acceptor-exciton unity, an optical bistability can be observed for non deliberately doped crystals. ESA

N90-30113# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
MANUFACTURING AND CHARACTERIZATION OF LIQUID-PHASE EPITAXY LAYERS WITH ATOMIC LEVELS AT THE CRYSTAL SURFACE AND AT THE HETERO LIMIT SURFACES IN THE SYSTEM GaAs-AlGaAs Ph.D. Thesis [HERSTELLUNG UND CHARAKTERISIERUNG VON FLUESSIGPHASENEPITAXIESCHICHTEN MIT ATOMAREN STUFEN AN DER KRISTALLOBERFLAECHE UND AN DEN HETEROGRENZFLAECHEN IM SYSTEM GAAS-ALGAAS]
Ulrich Morlock 1989 119 p In GERMAN Original contains color illustrations
(ETN-90-97310) Avail: NTIS HC A06/MF A01

A special crystal growth mechanism is realized by appropriate structuring of the Ga-As substrate. With a Nomarski differential interference contrast microscope, striations could be seen. The morphology of the striation sides changes for a critical temperature of 765 C from smooth to rough. For lower temperatures, the striation sides are parallel, equidistant and rectilinear. This experimental result can be explained by a roughening transition. Both heterogeneous boundary surfaces of the quantum wells appear in transmission electron microscopy at an atomic scale. The excitonic luminance spectra shows a separation of the signal into several lines. ESA

N90-30114# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
EXTENDED CHARACTERIZATION OF THE DAMAGE BY HOT CHARGE CARRIERS IN GATE OXIDE BY SHORT CHANNEL MOS FIELD EFFECT TRANSISTORS Ph.D. Thesis [ERWEITERTE CHARAKTERSIERUNG DER SCHAEDIGUNGEN DURCH HEISSE LADUNGSTRAEGER IM GATEOXID VON KURZKANAL-MOS-FELDEFFEKTTTRANSISTOREN]
Reinhard Mahnkopf 1989 112 p In GERMAN
(ETN-90-97313) Avail: NTIS HC A06/MF A01

Transistors from several technologies are tested by measurements of the capacities and the characteristic curves. A model allows obtaining of the gate and substrate currents. The damages at the phase limit and in the oxide are characterized by macroscopic current and voltage variations and by generated charge densities. For p-MOS (Metal Oxide Semiconductor) transistors, the production of oxide charges is the most important fact, in relation to the injected hot electrons; for n-MOS transistors, the generation of phase limit states is the main phenomenon. It is proved that the damages are located at the chain contact in the lateral direction but appear in the transistor channel with increasing functioning time or voltage. ESA

N90-30115# Royal Signals and Radar Establishment, Malvern (England).
PARAMETRIC TESTING FOR THE RSRE CMOS, SILICON ON SAPPHIRE PROCESS
D. J. Boller Feb. 1990 63 p
(RSRE-Memo-4369; BR113950; ETN-90-97608) Copyright Avail: NTIS HC A04/MF A01

The parametric testing methodology implemented to evaluate the outcome of RSRE (Royal Signals and Radar Establishment) CMOS, silicon on sapphire process in its development phase is described. The parametric testing methodology implemented is unconventional in that it seeks to validate the assumptions made when obtaining the parameter values sought rather than assuming that they are applicable. This is achieved by associating quality factors with each of the parameters evaluated, which will only be closed to their ideals when the assumptions made are valid. In addition, the procedures used to evaluate the parameters sought and the program subsequently employed to analyze the parametric data thus obtained do not require prior knowledge of the range of parameter values anticipated. This methodology was found to be of considerable value in practice, since it eliminates the need for an initial validation exercise and also checks that the assumptions which were originally made remain applicable as the process evolves. Whilst the methodology was only implemented for a CMOS, silicon on sapphire process, it could be employed with equal effect for any other semiconductor process during its development phase. ESA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N90-30116# International Centre for Theoretical Physics, Trieste (Italy).
ON DIRAC'S CONJECTURE FOR HAMILTONIAN SYSTEMS WITH FIRST AND SECOND CLASS CONSTRAINTS
Alejandro Cabo and Domingo Louis-Martinez (International School for Advanced Studies, Trieste, Italy) Jul. 1989 22 p Submitted for publication
(DE90-627206; IC-89/190) Avail: NTIS (US Sales Only) HC A03/MF A01

It is shown for a wide class of systems in the framework of the Total Hamiltonian Procedure that all the first class constraints generate canonical transformations connecting physically equivalent states. It occurs whenever the constraints arising in the Dirac algorithm are effective when considered in the functional form as they appear in the consistency conditions. The property of hereditary separation between first and second class constraints also follows from the above condition. General Poisson bracket relations among constraints in the representation used here are also obtained. The sources of anomalies in the hereditary property reported in the literature are identified. DOE

N90-30117# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
A NEW VECTOR-TENSOR THEORY AND HIGHER-DIMENSIONAL COSMOLOGY
K. Yoshida (Tokyo Metropolitan Univ., Japan) and K. Shiraishi Jan. 1990 15 p
(DE90-507990; INS-804) Avail: NTIS (US Sales Only) HC A03

A new vector-tensor model of classical gravity, which contains coupling between the field strength of the vector field and the curvature tensors in six dimensions, is proposed. Cosmological solutions of the scale factors in this model with the compactified space are obtained. The generalization of the model is also considered. DOE

N90-30118# Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study.
WORKSHOP ON LOW-DIMENSIONAL QUANTUM FIELD THEORY AND ITS APPLICATIONS
Hisashi Yamamoto, ed. Feb. 1990 326 p In JAPANESE; ENGLISH summary Workshop held in Tanashi, Japan, 18-20 Dec. 1989
(DE90-508071; INS-T-493; CONF-8912106) Avail: NTIS (US Sales Only) HC A15/MF A02

The workshop on 'Low-Dimensional Quantum Field Theory and its Applications' was held. Some pedagogical reviews and the latest results were delivered on the recent topics related to both solid-state and particle physics. Among them are quantum Hall effect, high T(sub c) superconductivity and related topics in low-dimensional quantum field theory. Many active discussions were made on these issues. DOE

N90-30119# International Centre for Theoretical Physics, Trieste (Italy).
ON A CALCULATION OF THE GROUND-STATE ENERGY IN QUANTUM MECHANICS
G. V. Efimov (International Centre for Theoretical Physics, Trieste, Italy) Jan. 1990 21 p Submitted for publication
(DE90-627182; IC-90/23) Avail: NTIS (US Sales Only) HC A03/MF A01

In nonrelativistic quantum mechanics the Wick-ordering method called the oscillator representation is suggested to calculate the ground-state energy for a wide class of potentials allowing the existence of a bound state. This method is especially effective for

the potentials which are strong in some sense and the standard perturbation theory is not applicable. Several examples are considered. DOE

N90-30120# International Centre for Theoretical Physics, Trieste (Italy).
INTRODUCTORY LECTURES ON CONFORMAL FIELD THEORY AND STRINGS
S. Randjbar-Daemi and J. Strathdee Jan. 1990 78 p
(DE90-627219; IC-90/22) Avail: NTIS (US Sales Only) HC A05/MF A01

The aim of these lectures is to provide an introduction to a first quantized formulation of string theory. This amounts to developing a consistent set of prescriptions for the perturbative computation of on-shell string amplitudes. The principal tool in this development is 2-dimensional conformal field theory on oriented manifolds of finite genus without boundaries (we treat only closed strings). This class of theory is much simpler than 4-dimensional quantum gravity with which it has many similarities. The geometry is not dynamical in this case, and the matter fields are not sensitive to local features of the geometry but only to global properties which can be characterized by a finite set of parameters (moduli). This can be formulated as field theory on a Riemann surface. We specialize mainly to free field theories for which the quantization problem can be completely solved by elementary means. An introduction to the general case will be given in Lectures 2 and 3 where the algebraic approach is discussed. The mathematics of Riemann surfaces is a well developed subject whose formalism is reviewed along with some of the principal theorems in Lecture 4. Physical string states are realized in the Hilbert space of a conformal field theory by the action of so-called vertex operators on the field theory vacuum state. Correlation functions of these vertex operators serve as ingredients for the computation of string amplitudes. They are to be integrated so as to include the contributions of all conformally inequivalent geometries, and a further manipulation (the GSO projection) is to be performed. These steps are to be regarded as part of the string prescription. DOE

N90-30121# Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering.
GAUSSONS AND STATES WITH GAUSSIAN WIGNER FUNCTIONS ARE QUASI-FREE STATES
H. Scutaru Apr. 1989 5 p
(DE90-628370; IFIN-FT-351-1989) Avail: NTIS (US Sales Only) HC A01/MF A01

The pure states with gaussian wave functions (Gaussons) and the states with gaussian Wigner functions are quasi-free states of the C algebra of canonical commutation relations. This remark furnishes a new, more transparent characterization of the gaussian functions on the phase space which are Wigner functions. A quantum momentum map for quasi-free states are labeled by the points of a coadjoint orbit of the symplectic group, on which second degree polynomials identities are satisfied. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N90-30122# Army War Coll., Carlisle Barracks, PA.
TOTAL QUALITY MANAGEMENT: A RECIPE FOR SUCCESS Study Project
Michael G. Pazak 2 Apr. 1990 53 p
(AD-A223287) Avail: NTIS HC A04/MF A01 CSCL 05/1

Total Quality Management (TQM) is a high level Department of Defense (DOD) initiative that is being touted as the primary management tool to force the fundamental cultural change in the way the DOD conducts business in the systems age. What is TQM. Where did it come from. What are it's guiding principles. How has it been used. What successes can be attributed to TQM. How can it best be implemented. These questions along with many others are addressed and answered in this work. In addition, an appendix of popular quality improvement models for organizations, their processes, and their individuals is provided. It was concluded that the DOD must embrace the TQM philosophy and proliferate it's principles in order to maximize the return on defense budget dollars. This will require an enormous investment in education, training and time and an equally positive commitment by the DOD leadership to create a DOD wide organizational climate that will stimulate and perpetuate individual productivity enhancing contributions. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N90-30123*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT MISSIONS. VOLUME 4B: DESCRIPTIONS OF DATA SETS FROM METEOROLOGICAL AND TERRESTRIAL APPLICATIONS SPACECRAFT AND INVESTIGATIONS
Carolyn Ng and G. Richard Stonesifer Sep. 1989 77 p
(NASA-TM-101880; NSSDC/WDC-A-R/S-89-10-Vol-4B; NAS 1.15:101880) Avail: NTIS HC A05/MF A01 CSCL 05B

The main purpose of the data catalog series is to provide descriptive references to data generated by space science flight missions. The data sets described include all of the actual holdings of the Space Science Data Center (NSSDC), all data sets for which direct contact information is available, and some data collections held and serviced by foreign investigators, NASA and other U.S. government agencies. This volume contains narrative descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations. The following spacecraft series are included: Mariner, Pioneer, Pioneer Venus, Venera, Viking, Voyager, and Helios. Separate indexes to the planetary and interplanetary missions are also provided. M.G.

N90-30124# Technische Hogeschool, Eindhoven (Netherlands). Faculty of Electrical Engineering.
BOOK OF ABSTRACTS OF THE 1ST BENELUX-JAPAN WORKSHOP ON INFORMATION AND COMMUNICATION THEORY Abstracts Only
Han Vinck, ed. Sep. 1989 31 p Workshop held in Eindhoven, Netherlands, 3-5 Sep. 1989 Prepared in cooperation with Philips Gloeilampenfabrieken N.V., Eindhoven, Netherlands; and Hitachi Ltd., Tokyo, Japan Sponsored in part by Fuji Photo Film Co. Ltd. and Werkgemeenschap Informatie-en Communicatie-Theorie
(PB90-191446; EUT-89-E-224; ISBN-90-6144-224-9) Avail: NTIS HC A03/MF A01 CSCL 05B

Abstracts of papers presented at the Workshop are given. Topics include partial-response decoding of rate 1/2 modulation codes for digital storage; erasure assignment for maximum distance separable codes; error correction on digital video recording; the performance of asynchronous frequency-hopped multilevel frequency shift keying spread-spectrum multiple-access systems; universal coding for data compression with side information; some aspects of a jointly Markov process when a marginal process is Markovian; variable quantization with arithmetic coding; the four cases for write-unidirectional memory codes over arbitrary alphabets; the foundation of speech coding systems with linear predictors; notes on weight distribution of R = k / n convolutional codes; variable-length source coding and error probability; very high speed soft-decision decoding for convolutional codes; modulation for optical recording channels; coding for binary multi-user channels; and video source coding for digital video recording. GRA

N90-30125 California Univ., Los Angeles.
TEXTUAL REGULARITIES APPLICABLE TO FULL TEXT SEARCHING: THE CASE OF FAMILY HISTORY LITERATURE Ph.D. Thesis
Mavis Bertha Molto 1989 354 p
Avail: Univ. Microfilms Order No. DA9014211

The increased availability of full text databases is accompanied by various searching problems, connected with natural language retrieval. Text analysis is considered as a means for identifying properties of specific subject domains that can be exploited in full text searching and in database and system design. The subject domain selected for analysis was family history literature. The primary research objective consisted of identifying properties of family history literature, relevant to full text search improvement and database and system design. Data were drawn from a sample of 200 family history articles, including text pertaining to selected males and females. Twenty-nine potential search terms, useful as limiting elements in common and homographic name searching, were examined with regard to each of the sampled persons. The search terms included the subject's first, last, and married names, along with certain kinship terms and life event terms. The family history articles were relatively short in length and contained a limited number of graphical items, with associated implications for database and system design. Personal name terms occurred in higher frequencies than life event terms, for both males and females, with higher recall thus expected with personal names than with the life event terms. Certain search term frequencies differed significantly with respect to gender, suggesting differing search strategies for males versus females. Search term synonyms, homographs, form variations, and co-occurrence patterns were also identified, with additional implications for searching. The secondary research objective focused on determining the sublanguage status of family history literature. Frequency comparisons were made for six word categories (proper nouns, numbers, kinship nouns, life event nouns, life event verbs, and pronouns) in a 19,874 word family history corpus and the Brown corpus, a one million word sample from general English. The family history literature differed significantly from general English in the word category frequencies, providing evidence for sublanguage status. Dissert. Abstr.

N90-30126 University of South Florida, Tampa.
SEARCH STRATEGIES FOR COMPUTER-STORED INFORMATION: A MICROCOMPUTER TUTORIAL Ph.D. Thesis
Elizabeth Szyszkowsk Smith 1989 245 p
Avail: Univ. Microfilms Order No. DA9014646

A microcomputer tutorial teaching end users basic search strategies for retrieving computer stored information, using Boolean Operators was developed and tested. The tutorial, based on Ausubel's Meaningful Learning Theory, Gagne's External Events of Instruction, and Novak's Concept Mapping Technique, consists of four lessons and a practice exercise. Evaluation of the tutorial consisted of content validation, pilot testing, and criterion validation. Thirty undergraduate education majors with no prior knowledge of online searching were randomly assigned to either the control or the experimental group, each consisting of 15 students. The experimental group worked through the tutorial; the control group was given a control tutorial. After completing the programs, each member in both groups formulated three search statements on three topics selected by the researcher. Statement of both groups were input online into the ERIC database in natural language using Dialog. Searches were limited to 10 citations in full record format. The results yielded 638 documents, 234 from the control and 404 from the experimental group. Citations were evaluated for relevancy by the researcher using the binary system of judgment. Relevancy was determined by descriptors or keywords in the abstract in correct context. Viability of the tutorial as a method of teaching search strategies was established. Implications are minifold: information available on computer cannot be accessed by many. Thus the role of the librarian is changing from searcher of information to teaching searching skills, which can be enhanced with this tutorial. Similar role shifts for teachers can occur. Results indicate that persons with no knowledge of computer searching can learn searching skills quickly utilizing this tutorial. Judgments of relevancy, despite guidelines, are subjective. Dissert. Abstr.

N90-30127# National Inst. of Standards and Technology, Gaithersburg, MD. National Computer Systems Lab.
WORKING IMPLEMENTATION AGREEMENTS FOR OPEN SYSTEMS INTERCONNECTION PROTOCOLS
Tim Boland, ed. Feb. 1990 355 p Presented at the NIST Workshop for Implementors of OSI Plenary Assembly, 15 Dec. 1989, Gaithersburg, MD
(PB90-197948; NISTIR-90/4247) Avail: NTIS HC A16/MF A02 CSCL 05B

Current agreements on implementation details of Open Systems Interconnection Protocols among the organizations participating in the National Institute of Standards and Technology/Open Systems Integration (NIST/OSI) Workshop Series for Implementors of OSI Protocols are documented. These decisions are documented to facilitate organizations in their understanding of the status of agreements. GRA

N90-30128# Naval Postgraduate School, Monterey, CA.
ACCESSING NETWORK DATABASES VIA SQL TRANSACTIONS IN A MULTI-MODEL DATABASE SYSTEM M.S. Thesis
Dennis A. Walpole and Alphonso L. Woods Dec. 1989 77 p
(AD-A223946) Avail: NTIS HC A05/MF A01 CSCL 12/7

Traditional approaches to database-system design and implementation involve single-model, single-language database systems with their inherent lack of flexibility and extensibility. An alternative to the traditional approach to database-system design and implementation is the multi-lingual database system (MLDS). This approach allows the user with the user's familiar data language to access and update one or more unfamiliar databases in different data models as if they are in the user's familiar data model. Thus, MLDS has the flexibility and extensibility in database accesses. A methodology is presented for the relational user to access and update network databases with a relational data language. Specifically, an interface was designed for allowing the relations/SQL user to access a network database via SQL (structured query language) transactions. The functionality of MLDS is further extended. GRA

N90-30129# Boston Coll., Chestnut Hill, MA. Inst. for Space Research.
DATABASE DEVELOPMENT FOR THE DMSP EXPERIMENTS Final Report, 1 Jan. 1987 - 31 Dec. 1989
Dennis E. Delorey, Paul N. Pruneau, Carolyn M. Parsons, and Brian J. Donovan 31 Jan. 1990 66 p
(Contract F19628-87-K-0008)
(AD-A224346; BC-ISR-90-001; GL-TR-90-0028) Avail: NTIS HC A04/MF A01 CSCL 12/7

Processed data bases for the SSJ-4, SSM, SSJ-STAR and the SSIES experiments flown on-board the F6, F7, F8 and F9 DMSP vehicles have been created and/or maintained over the lifetimes of the four satellites. An historical overview of the DMSP (Defense Meteorological Satellite Program) project is presented. A description

of each of the various payloads on-board the spacecrafts is provided. The data processing systems and associated computer developed for each of the various experiments are described. Relevant calibration tables are provided. And, the formats of the individual data bases associated with each stage of the processing are described. GRA

N90-30130# George Mason Univ., Fairfax, VA. Dept. of Information Systems and Systems Engineering.
A SURVEY OF OBJECT-ORIENTED DATABASE TECHNOLOGY Final Technical Report, Jun. - Dec. 1989
Boshan Thomas, Akhil Agrawal, Sushil Jajodia, and Boris Kogan May 1990 47 p
(Contract F30602-88-D-0028; AF Proj. 1068)
(AD-A224490; RADC-TR-90-90) Avail: NTIS HC A03/MF A01 CSCL 12/7

For many applications, traditional data base models and technologies have proven inadequate, and this has led to research and development of database technologies based on the object-oriented paradigm. Some of the recent research and development in object-oriented databases are surveyed. The core concepts that are being considered in developing a unified object-oriented data model are discussed, followed by some of the architectural issues involved in developing object-oriented database management systems. Technical summaries of two prototype object-oriented database products, GEMSTONE AND ORION, are given. Also, some of the exciting future research directions are highlighted. GRA

N90-30131# Pennsylvania State Univ., University Park. Applied Research Lab.
ANALYSIS AND SYNTHESIS OF ROBUST DATA STRUCTURES
A. Ravichandran and K. Kant Aug. 1990 121 p
(Contract N00039-88-C-0051)
(AD-A224568; PSU/ARL/TR-90-010) Avail: NTIS HC A06/MF A01 CSCL 12/7

There is an increasing interest in applications in which the reliability of a computing system is of utmost importance. Also, it is likely that the availability of reliable computing systems would promote their use in critical application areas. One approach to increasing the reliability of computer software is by increasing the robustness of data structures used. A formal approach is provided for the analysis and synthesis of robust data structures. The entire data structure is viewed as a collection of data elements related via some attributes. The relationships are specified by a set of axioms in first order logic. Faults in attributes invalidate some of the axioms. The invalidated axioms are used to detect and correct the faulty attributes. Sufficient, and in many cases, necessary conditions for achieving a given level of detectability and correctability. The notion is discussed of compensations and extend our design to tolerate compensating faults. GRA

N90-30132*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXTERNAL INFORMATION SOURCES AND AEROSPACE R/D: THE USE AND IMPORTANCE OF TECHNICAL REPORTS BY US AEROSPACE ENGINEERS AND SCIENTISTS
Walter R. Blados, Thomas E. Pinelli, John M. Kennedy, and Rebecca O. Barclay (Rensselaer Polytechnic Inst., Troy, NY.) Mar. 1990 19 p Presented at the 68th AGARD National Delegates Board Meeting, Toulouse, France, 29 Mar. 1990 Submitted for publication
(NASA-TM-101232; NAS 1.15:101232; AD-A223359; USAF-STINFO-90/5; SAF/AQT-SR-90-009) Avail: NTIS HC A03/MF A01 CSCL 05/2

This paper formulates and studies two propositions. Proposition 1 states that information that is external to the aerospace organization tends to be used less than internal sources of information; the more geographically removed the information is from the organization, the less likely it is to be used. Proposition 2 states that of the various sociometric variables assumed to influence the use of an information channel or source, perceived accessibility exerts the greatest influence. Preliminary analysis based on surveys supports Proposition 1. This analysis does not support Proposition 2, however. Evidence here indicates that reliability and relevance influence the use of an information source more than the idea of perceived accessibility. GRA

N90-30133# Human Engineering Labs., Aberdeen Proving Ground, MD.
INFORMATION PROCESSING AND PERCEPTUAL CHARACTERISTICS OF DISPLAY DESIGN: THE ROLE OF EMERGENT FEATURES AND OBJECTS Final Report
Anthony D. Andre and Christopher D. Wickens (Illinois Univ., Savoy.) May 1990 29 p
(DA Proj. 1L1-62716-AH-70)
(AD-A223683; HEL-TM-7-90) Avail: NTIS HC A03/MF A01 CSCL 12/7

In this report, the fundamental theoretical and applied principles are outlined, which have been cited to justify the relative benefits of object displays, the representation of several quantitative variables as features of single geometric objects. In particular, the proximity compatibility principle is described, which asserts that object displays will facilitate information integration tasks but will disrupt tasks that require focused attention on the individual dimensions of the object. Finally, an experiment is described contrasting three displays: a monochrome object, a multicolor object, and a separated bar graph display. Subjects were required to either integrate or focus attention on one of three sources of displayed information in an aircraft stall judgment task. Evaluation of the monochrome object revealed superior integration performance but degraded focused attention performance relative to the bar graph display, thus illustrating the proximity compatibility principle. The multicolored object, in contrast, emerged as a display concept that could potentially support accurate integration and focused attention performance, highlighting the role of emergent features and color coding, and suggesting some modifications of the proximity compatibility principle. The results are discussed in terms of their theoretical and practical application to multi-element interface design. GRA

N90-30134# Sandia National Labs., Albuquerque, NM.
SMALL MULTIPURPOSE STORED DATA ACQUISITION SYSTEM
G. C. Hauser and D. E. Ryerson 1990 5 p Presented at the International Telemetering Conference, Las Vegas, NV, 29 Oct. 1990
(Contract DE-AC04-76DP-00789)
(DE90-010823; SAND-90-0985C; CONF-901074-1) Avail: NTIS HC A01/MF A01

Sandia National Laboratories Telemetry Department has designed and is fielding a small, inexpensive multipurpose stored data acquisition system in tests ranging from 6000 meters below the ocean surface in seafloor penetrators to 40,000 meters above sea level in gamma ray telescope balloons. The system consists of a simple microprocessor-controlled unit which digitizes analog data and stores the data in memory for readout after the test by a portable personal computer. The system has been used in over ninety tests consisting of parachute drops, water entry test, vehicle environmental monitoring, and seafloor penetration tests. Data typically recorded with the system are acceleration, strain, temperature, pressure, and angular velocity. The system is also capable of generating control functions such as parachute release. DOE

N90-30135# Oak Ridge National Lab., TN.
KNOWLEDGE-BASED EXPERT SYSTEM CONFIGURATOR
K. A. Wakefield and S. S. Gould 1990 8 p Presented at the International Conference and Exhibition of the Instrument Society of America, New Orleans, LA, 14-19 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE90-011711; CONF-901017-2) Avail: NTIS HC A02/MF A01

The term knowledge-based expert system usually brings to mind a rather extensive list of commercially available expert system shells with the associated complexity of implementing the given

inferencing strategies to drive a rule base of knowledge for solving particular classes of problems. A significant amount of learning time is required to understand all of the intricacies of the systems in order to effectively utilize their salient features while working around the canned constraints. The amount of effort required to prototype the first attempt is therefore substantial and can quickly lead to the unfortunate effect of reticence toward applying expert systems. This paper describes an alternative approach to use of specialized shells in developing or prototyping first-attempting knowledge-based expert systems using Lotus 123, a commonly used spreadsheet software package. The advantages of using this approach are discussed. The working example presented makes use of the forward-chaining capabilities available to determine automatically the hardware jumper and switch configuration for a distributed process control system. Hardware configuration control documentation is generated for use by field engineers and maintenance technicians. DOE

N90-30136# Sandia National Labs., Albuquerque, NM.
INTEGRATION OF INFORMATION SYSTEMS COMPONENTS
Ronald C. Hall and John K. Sharp Apr. 1990 14 p
(Contract DE-AC04-76DP-00789)
(DE90-011761; SAND-89-1810) Avail: NTIS HC A03/MF A01

Several components of information systems are described which must be successfully integrated in order to accomplish an effective implementation of software to accommodate particular business needs. Interfaces are identified wherein application systems can be constructed to meet requirements derived from an appropriate model of the business environment. Database systems provide an organization for presenting the necessary information (data and relationships) through a medium which the applications can effectively access to accomplish their work. This presentation medium is based on an information model which captures the essence of the information needs and structure required to carry out the business of the enterprise. Methodology based upon integration of these components is being employed in the Product Data Systems Management and Development Division, 2825, at Sandia National Laboratories in order to carry out information-systems engineering responsibilities. DOE

N90-30137# Department of Energy, Washington, DC.
FEDIX: AN ON-LINE INFORMATION SERVICE FOR UNIVERSITIES AND OTHER RESEARCH ORGANIZATIONS: USER'S GUIDE
Sep. 1990 56 p
(DE90-014835; DOE/ER-0466P) Avail: NTIS HC A04/MF A01

FEDIX is an on-line information service that links the higher education community and the Federal government to facilitate research, education, and services. The system provides accurate and timely Federal agency information to colleges, universities, and other research organizations. There are no registration fees and no access charges for using FEDIX. The only cost is for the phone call. Currently FEDIX contains information on the Department of Energy (DOE), Office of Naval Research (ONR), and National Aeronautics and Space Administration (NASA). Additional government agencies are expected to join FEDIX in the future. This guide is intended to help users access and utilize the FEDIX system. Because the system requires frequent updating, however, some menus and tables used in this text as examples may not exactly match those displayed on the on-line system. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N90-30138# Committee on Science, Space and Technology (U.S. House).
NASA AUTHORIZATION, 1991, VOLUME 2
Washington GPO 1990 702 p Hearings before the Committee on Science, Space, and Technology, 101st Congress, 2d Session, no. 129, 6, 8, 21, and 27 Feb. 1990
(GPO-32-196) Avail: Subcommittee on Space Science and Applications, House of Representatives, Washington, DC 20515 HC free; also available SOD HC $20.00 as 552-070-06879-2

The hearing of the Subcommittee on Space Science and Applications of the Committee on Science, Space, and Technology of the 101st Congress is presented. It was held at the full committee because the nature of the proposed budget signifies some profound changes that will have far-reaching effects on the space program for the 21st century. It was noted that the budget request represents an increase of 23 to 24 percent over the previous year, but that the government's investment in civil space and aeronautics has been steadily reduced since the mid-1960's. Statements were made by NASA Administrator Richard H. Truly and a team of Associate Administrators, Deputy Associate Administrators, and others. Budget items discussed include the national aerospace plane, space transportation, the Space Station Freedom, global changes on earth, space exploration, tracking, facilities, research, technology, applications, and public outreach programs. J.P.S.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N90-30139# Pacific Northwest Lab., Richland, WA.
THE TECHNOLOGY TRANSFER PROCESS: BACKGROUND FOR THE NATIONAL ENERGY STRATEGY
D. E. Deonigi and N. L. Moore Jun. 1990 18 p Presented at the 15th Annual Technology Transfer Society Meeting, Dayton, OH, 25-28 Jun. 1990
(Contract DE-AC06-76RL-01830)
(DE90-015301; PNL-SA-17857; CONF-9006221-3) Avail: NTIS HC A03/MF A01

This paper is based on our White Paper, which was background for the technology transfer section of the U.S. Department of Energy's (DOE) National Energy Strategy (NES), and a subsequent survey, which was conducted to characterize the technology transfer programs throughout DOE. From 172 selected technology transfer case studies, Pacific Northwest Laboratory characterized DOE's 7 major programs. This paper describes the objectives, strategies, and mechanisms that DOE and its laboratories use in their technology transfer programs. Technology transfer is defined for the purposes of this paper as the process by which technology, knowledge, and/or information developed in one organization, in one area, or for one purpose is applied and used in another organization, in another area, or for another purpose. The end user may be the public, industry, another Federal laboratory, or any other technology developer. Technology information can be a simple energy conservation practice for public use, databases, a patent of an invention, a report on the properties of a magnetic field, an improved industrial process, or a new procedure for handling a hazardous material. Some technologies are identified as potential commercial successes and are transferred to the

private sector early in the development process; other technologies are not transferred until they are fully developed and tested. Mechanisms to facilitate technology transfer by providing feedback from the end user to the developer, such as advisory groups with potential users as members, tend to be effective ways to accelerate transfer and technology utilization. DOE

88 SPACE SCIENCES (GENERAL)

N90-30140*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT MISSIONS. VOLUME 3B: DESCRIPTIONS OF DATA SETS FROM LOW- AND MEDIUM-ALTITUDE SCIENTIFIC SPACECRAFT AND INVESTIGATIONS
John E. Jackson, ed. and Richard Horowitz, ed. Apr. 1986 105 p
(NASA-TM-89680; NSSDC/WDC-A-R/S-86-01-Vol-3B; NAS 1.15:89680) Avail: NTIS HC A06/MF A01 CSCL 03B

The main purpose of the data catalog series is to provide descriptive references to data generated by space science flight missions. The data sets described include all of the actual holdings of the Space Science Data Center (NSSDC), all data sets for which direct contact information is available, and some data collections held and serviced by foreign investigators, NASA and other U.S. government agencies. This volume contains narrative descriptions of data sets from low and medium altitude scientific spacecraft and investigations. The following spacecraft series are included: Mariner, Pioneer, Pioneer Venus, Venera, Viking, Voyager, and Helios. Separate indexes to the planetary and interplanetary missions are also provided. M.G.

N90-30141# European Space Agency, Paris (France). Space Science Dept.
ESA'S REPORT TO THE 28TH COSPAR MEETING
A. Chicarro, V. Domingo, U. O. Frisk, P. Jakobsen, K. Knott, M. F. Kessler, J. P. Lebreton, R. Marsden, A. Peacock, and M. A. C. Perryman et al Jun. 1990 137 p Meeting held in The Hague, The Netherlands, Jun. 1990 Original contains color illustrations
(ESA-SP-1124; ISSN-0379-6566; ETN-90-97588) Copyright Avail: NTIS HC A07/MF A01

Ongoing and complete missions, including IUE, EXOSAT, Hipparcos and Giotto, are discussed. Projects under development, including Ulysses, Hubble Space Telescope, ISO (Infrared Space Observatory), the Solar Terrestrial Science Programme (STSP), Cassini/Huygens and the high throughput X ray spectroscopy mission (XMM), are reported. Missions under study are reviewed; the submillimeter spectroscopy mission (FIRST); Rosetta CNSR (Comet Nucleus Sample Return); third millenium Mars exploration, interferometry from space and Vulcan missions. The Eureca A and Columbus Polar Platforms are included. ESA

N90-30142# European Space Agency, Paris (France).
[ACTIVITIES REPORT OF THE SPACE SCIENCE DEPARTMENT] Annual Report, 1988-1989
M. C. E. Huber, comp., A. Pedersen, comp., B. G. Taylor, comp., K.-P. Wenzel, comp., and Valerie David, ed. Jun. 1990 149 p Original contains color illustrations
(ESA-SP-1126; ISBN-92-9092-076-9; ETN-90-97589) Copyright Avail: NTIS HC A07/MF A01

The research and development carried out is reported. Divisions covered are solar and heliospheric science, planetary and space, astrophysics, and symposia and workshops. The research and support to projects and studies is reviewed. Research in astrophysics carried out in the EXOSAT and IUE laboratories is reported. ESA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N90-30143*# Lockheed Missiles and Space Co., Palo Alto, CA. Solar and Astrophysics Lab.
INVESTIGATION OF X RAY VARIABILITY IN HIGHLY ACTIVE COOL STARS Final Report
Robert A. Stern 30 Sep. 1989 18 p
(Contract NAS8-37655)
(NASA-CR-183853; NAS 1.26:183853) Avail: NTIS HC A03/MF A01 CSCL 03A

Ginga x ray observations of highly active cool star coronae were obtained and analyzed in an effort to better understand the nature of their time variability. The possible types of variability studied included x ray occultations via eclipses in a binary system, rotational modulation of x ray emission, flares, and a search for microflaring. Observation of both sigma(sup 2) CrB and Algol were performed successfully by Ginga. The sigma(sup 2) CrB observations occurred on 27 to 30 June 1988, and the Algol observations on 12 to 14 January 1989. In the sigma(sup 2) CrB observation, simultaneous IUE and Very Large Array (VLA) observations were obtained during part of the Ginga observation. Flaring activity was detected on sigma(sup 2) CrB in the Ginga 1.7 to 11 KeV band and in the IUE microwave region. A large flare on Algol which lasted well over 12 hours was detected, began with a maximum temperature of 65 MK which gradually decayed to 36 MK, and evidence was shown of highly ionized Fe line emission. B.G.

N90-30144 Harvard Univ., Cambridge, MA.
INTERSTELLAR MAGNETIC FIELDS: AN OBSERVATIONAL PERSPECTIVE Ph.D. Thesis
Alyssa Ann Goodman 1989 272 p
Avail: Univ. Microfilms Order No. DA9013213

The plausibility of magnetic molecular clouds is established. It is shown that the empirically known relations between spectral line width, density, and cloud size can be derived from a virial equilibrium model where gravity is balanced by the sum of magnetic and pressure support. It is shown that substitution of measured density, cloud size, and line width measurements into the model can predict observed field strength to within a factor of two. The Zeeman effect is discussed and new measurements are presented for magnetic field strength based on OH and HI Zeeman observations at the Arecibo and Green Bank telescopes. The Barnard 1 (B1) region, in the Perseus Molecular Cloud Complex, is discussed in detail. OH spectral line intensity maps are presented for the regions where the OH Zeeman effect was observed, which allow, for the first time, comparison of observed field strength values with predicted field strength values, using emission from a single molecular species. Spatial structure of magnetic fields in molecular clouds are investigated. New optical polarization maps are presented for the dark clouds in Perseus, Taurus, and Ophiuchus. The polarization observed is attributed to preferential extinction of background starlight by magnetically aligned dust grains in the clouds, and we analyze the polarization maps as maps of the projection of the magnetic field onto the plane of the sky. Dissert. Abstr.

N90-30145 Yale Univ., New Haven, CT.
AN OBSERVATIONAL STUDY OF DISK-POPULATION GLOBULAR CLUSTERS Ph.D. Thesis
Taft Emerson Armandroff 1988 179 p
Avail: Univ. Microfilms Order No. DA9015820

Integrated-light spectroscopy was obtained for twenty-seven globular clusters at the Ca II infrared triplet. Line strengths and radial velocities were measured from the spectra. For the well-studied clusters in the sample, the strength of the CA II lines is very well correlated with previous metallicity estimates obtained using a variety of techniques. The greatly reduced effect of interstellar extinction at these wavelengths compared to the blue region of the spectrum has permitted observations of some of the most heavily reddened clusters in the Galaxy. For several such

clusters, the Ca II triplet metallicities are in poor agreement with metallicity estimates from infrared photometry by Malkan. Color-magnitude diagrams were constructed for six previously unstudied metal-rich globular clusters and for the well-studied cluster 47 Tuc. The V magnitudes of the horizontal branch stars in the six clusters are in poor agreement with previous estimates based on secondary methods. The horizontal branch morphologies and reddenings of the program clusters were also determined. Using the improved set of metallicities, radial velocities, and distance moduli, the spatial distribution, kinematics, and metallicity distribution of the Galactic globulars were analyzed. The revised data supports Zinn's conclusion that the metal-rich clusters form a highly flattened, rapidly rotating disk system, while the metal-poor clusters make up the familiar, spherically distributed, slowly rotating halo population. The scale height, metallicity distribution, and kinematics of the metal-rich globulars are in good agreement with those of the stellar thick disk, in support of the association of metal-rich clusters with the thick-disk population. Luminosity functions were constructed, and no significant difference is found between disk and halo samples. Metallicity gradients seem to be present in the disk cluster system. The implications of these results for the formation and evolution of the Galaxy are considered.
Dissert. Abstr.

N90-30146 Pennsylvania Univ., Philadelphia.
ABSOLUTE WIND MEASUREMENTS IN THE LOWER THERMOSPHERE OF VENUS USING INFRARED HETERODYNE SPECTROSCOPY Ph.D. Thesis
Jeffrey Jay Goldstein 1989 430 p
Avail: Univ. Microfilms Order No. DA9015098

The first absolute wind velocities above the cloud-tops were obtained using infrared heterodyne spectrometers at the NASA Infrared Telescope Facility and the McMath Solar Telescope, December 1985 to March 1987, during four planetary phases spanning 82 percent of a synodic period. Bean-integrated Doppler displacements in the non-thermal emission core of (12)C(16)O2 10.33 microns R(8) (obtained at sub-Doppler resolution), sampled the line of sight projection of the lower thermospheric wind field (100 to 120 km). A field-usable Lamb-dip laser stabilization system, developed for spectrometer absolute frequency calibration to less than +/- 0.1 MHz, allowed S/N-limited line of sight velocity resolution at the 1 m/s level. The spectrometer's diffraction-limited beam and 1-2 arc-second seeing, provided the spatial resolution necessary for circulation model discrimination. Qualitative analysis of beam-integrated winds definitively established a dominant subsolar-antisolar circulation in the lower thermosphere. A retrograde zonal component was also suggested. Beam-integrated winds were modelled with a 100 x 100 grid over the beam, incorporating beam spatial rolloff and across-the-beam gradients in non-thermal emission intensity, line of sight projection geometry, and horizontal wind velocity. Horizontal wind velocity was derived from a 2-parameter model wind field comprised of subsolar-antisolar and zonal components. Best-fit models indicated a dominant subsolar-antisolar flow with 120 m/s cross-terminator winds and a retrograde zonal component with a 25 m/s equatorial velocity. Detection of a significant zonal component indicates upper thermospheric super-rotation may be coupled to, hence pumped by, cloud level super-rotation. Early heterodyne mesospheric wind measurements were re-examined based on laser stability test results. A review of all dynamical indicators above the cloud-tops allowed development of an integrated and self-consistent picture of circulation in the 70 to 200 km range. Dissert. Abstr.

N90-30147# Lawrence Livermore National Lab., CA.
MONTE CARLO SIMULATION OF COMPLEX SPECTRA FOR OPACITY CALCULATIONS
M. Klapish (California Univ., Berkeley. Lawrence Berkeley Lab.), P. Duffy, and W. Goldstein Jun. 1990 16 p Presented at the American Astronomical Society Meeting, Albuquerque, NM, 10-14 Jun. 1990 Submitted for publication
(Contract W-7405-eng-48)
(DE90-015198; UCRL-102955; CONF-9006256-1) Avail: NTIS HC A03/MF A01

Calculating stellar opacities often involves calculating spectra containing millions of lines. Current methods for doing this are not always adequate. Exact calculations of these spectra can take too long to be practical, and the Unresolved Transition Array (UTA) approach, which assumes individual lines are not resolved, often gives very poor results. We are developing a new, Monte-Carlo approach to calculating opacities of complex spectra which is much faster than exact calculations and gives much better results than the UTA approach. The key idea is that to calculate opacities over small wavelength ranges, it is not necessary to know the correct wavelengths or strengths of individual lines. As long as certain statistical properties of the spectrum are correct, calculated opacities will be approximately right. All the atomic physics in our model is of a statistical nature; we do not calculate the real strength or energy of any lines. Specific properties which our Monte Carlo Spectra reproduce are the total strength of all lines, their mean wavelength, and their wavelength spread, as well as the statistical distribution of line strengths. We do this separately for each transition array in the spectrum. In several test cases where exact calculations are possible, our model gives Rosseland mean opacities from about three times less than to the same as the exact result. By comparison, the UTA approach gives results orders of magnitude too large. In these cases our results vary by about 10 percent from run to run due to statistical fluctuations; in cases of real interest, which involve more lines, these variations should be smaller. DOE

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N90-30148*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT MISSIONS. VOLUME 1B: DESCRIPTIONS OF DATA SETS FROM PLANETARY AND HELIOCENTRIC SPACECRAFT AND INVESTIGATIONS
Richard Horowitz, comp., John E. Jackson, comp., and Winifred S. Cameron, comp. Apr. 1987 156 p
(NASA-TM-89695; NSSDC/WDC-A-R/S-87-03-Vol-1B; NAS 1.15:89695) Avail: NTIS HC A08/MF A01 CSCL 03B

The main purpose of the data catalog series is to provide descriptive references to data generated by space science flight missions. The data sets described include all of the actual holdings of the Space Science Data Center (NSSDC), all data sets for which direct contact information is available, and some data collections held and serviced by foreign investigators, NASA and other U.S. government agencies. This volume contains narrative descriptions of planetary and heliocentric spacecraft and associated experiments. The following spacecraft series are included: Mariner, Pioneer, Pioneer Venus, Venera, Viking, Voyager, and Helios. Separate indexes to the planetary and interplanetary missions are also provided. M.G.

N90-30149*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
INTERPLANETARY MEDIUM DATA BOOK, SUPPLEMENT 4, 1985-1988
Joseph H. King Sep. 1989 244 p
(NASA-TM-101867; NSSDC/WDC-A-R/S-89-17-Suppl-4; NAS 1.15:101867) Avail: NTIS HC A11/MF A02 CSCL 03B

An extension is presented of the series of Interplanetary Medium Data Books and supplements which have been issued by the National Space Science Data Center since 1977. This volume contains solar wind magnetic field (IMF) and plasma data from the IMP 8 spacecraft for 1985 to 1988, and 1985 IMF data from the Czechoslovakian Soviet Prognoz 10 spacecraft. The normalization of the MIT plasma density and temperature, which has been discussed at length in previous volumes, is implemented

as before, using the same normalization constants for 1985 to 1988 data as for the earlier data. E.R.

N90-30150 Massachusetts Univ., Amherst.
FORMATION OF HYDROGEN LINE AND CONTINUUM EMISSION IN YOUNG STELLAR OBJECTS Ph.D. Thesis
Jose Luis Alonso 1989 199 p
Avail: Univ. Microfilms Order No. DA9011691

Two mechanisms were identified that populate the n = 2 level of hydrogen after the Lyman continuum is depleted. They are: ionization of N I from its excited states, followed by charge-exchange between N II and H I, and Ly Beta line wing absorption. Both processes involve absorption of the sub-Lyman continuum between 11 and 13.6 eV. With population in level n = 2 maintained, the strong Brackett line fluxes observed from young stellar objects (YSOs) are then produced as a result of Balmer continuum photoionization. Performing numerical calculations for four YSOs whose luminosities range from approximately 10(exp 4) to 10 solar luminosity, it was concluded that this two-step process of sub-Lyman continuum absorption followed by Balmer photoionization can account for a great majority of observed Brackett line and radio continuum fluxes. The calculated values of Br gamma/Br alpha (0.3 to 1.8) and Pf gamma/Br alpha (0.1 to 0.7) are also consistent with de-reddened observed ratios. A detailed analysis of the dependence of Br gamma/Br alpha and other hydrogen line ratios on the physical parameters of the gas cloud is presented. It is found that Pf gamma/Br gamma is nearly independent of the physical conditions in the emitting gas. Using this result, a new method is presented to estimate the amount of obscuration towards YSOs. For YSOs of luminosity approximately 10(exp 3)-10(exp 4) solar luminosity, Br gamma/Br alpha is moderately useful as an indicator of distance of the gas cloud from the YSO. If the distance of the cloud from the YSO can be determined, an estimate of the column density of the cloud can be obtained from the observed values of Br gamma/Br alpha and Pf beta/Br gamma. Dissert. Abstr.

N90-30151 Massachusetts Univ., Amherst.
CARBON MONOXIDE ISOTOPES AND CLUMPING IN GIANT MOLECULAR CLOUDS Ph.D. Thesis
David Kent Taylor 1989 311 p
Avail: Univ. Microfilms Order No. DA9011806

The J = 1 yields 0 transition of CO, CO-13, and CO-18 was observed in a number of molecular clouds in both the inner Galaxy and the outer Galaxy in order to determine carbon and oxygen isotopic abundances. The same species was also observed in the nearby giant molecular cloud NGC 2264 and obtained a similar previously-published data set for the dark cloud L134N. It was found that the CO-13 to CO-18 column density ratios in NGC 2264 are 2 to 4 times larger than those in L134N, although both data sets show an increase in this quantity with decreasing CO-18 column density, presumably due to isotopic fractionation. Because GMCs are believed to be strongly clumped on both observational and theoretical grounds, whereas dark clouds are not, an explanation of the GMC-dark cloud distinction was sought. The clumpy cloud GMC model of Kwan and Sanders (1986) was adopted, but a self-consistent low-extinction chemical model incorporating CO-13 fractionation and isotope-selective photodissociation was used to determine the carbon monoxide isotopic abundances in the outer regions of the clumps. The clumpy GMC model reproduced the observed trend of increasing CO-13 to CO-18 column density ratio as the CO-18 column density decreases over a wide range of global model parameters. The model was deficient, however, in quantitatively realizing the magnitude of the effect, typically falling short by approximately 50 percent. A number of obvious simplifications in the model leads to the conclusion that a more realistic clumped model would have little difficulty matching the observational data much more closely. Dissert. Abstr.

N90-30152 Yale Univ., New Haven, CT.
THE EVOLUTION OF HORIZONTAL BRANCH STARS AND THE CALIBRATION OF GLOBULAR CLUSTER AGES Ph.D. Thesis
Young-Wook Lee 1989 203 p
Avail: Univ. Microfilms Order No. DA9015834

Synthetic models of the horizontal branches in globular clusters were constructed from a new grid of standard horizontal branch (HB) evolutionary tracks. These models were used to investigate the period shifts at constant temperature between the RR Lyrae variables in globular clusters of different metallicities and the variation in HB luminosity with Fe/H . It is shown that two effects--the evolution away from the zero-age horizontal branch (ZAHB) and the non-universal relationship between rise time (or amplitude) and effective temperature--are responsible for the disagreement between the HB luminosity-Fe/H relationship found observationally by Sandage (1982) in his investigation of the Oosterhoff effect and the one given by calculations of ZAHB stars. When these two effects are taken into account, the observed relationship between period shift and Fe/H, matches the theoretical model calculations to within the errors. The resulting relation between the mean luminosity of the RR Lyrae variables and Fe/H has approximately one-half the slope of Sandage's relation, which yields a significant correlation between age and Fe/H among the globular clusters that spans approximately 4 Gyrs (for constant O/Fe) over the metallicity range of the galactic halo. The synthetic HB models are also used to investigate the second parameter phenomenon among the galactic globular clusters system. This investigation confirms the earlier suggestion that there is a systematic variation of the second parameter effect with galactocentric distance. It is shown that full consistency with the pulsation theory and with the standard theory of both turnoff and HB evolution can only be achieved if age is the second parameter that most determines the HB morphology. Dissert. Abstr.

N90-30153# Arizona Univ., Tucson. Steward Observatory.
THE TEMPEL 2 DUST TRAIL
M. V. Sykes, R. G. Walker, and D. J. Lien 28 Sep. 1989 24 p
(Contract F19628-87-K-0045)
(AD-A224395; GL-TR-89-0268; SR-2) Avail: NTIS HC A03/MF A01 CSCL 03/2

Observations of cometary dust at visual wavelengths are dominated by particles microns in size. At thermal wavelengths emissions from submillimeter and larger particles become important. Dust trails are phenomena which were first detected by the Infrared Astronomical Satellite (IRAS), and have been identified as large debris covering portions of the orbits of short-period comets. The Tempel 2 Dust Trail was extensively observed by the IRAS. Evidence is presented suggesting that the trail is composed of particles on the order of 1 mm and large in diameter with velocities of several meters per second relative to the parent comet, assuming isotropic emission. Trail particles forward of the comets orbital position have a minimum diameter of approx. 6 mm. These particles were emitted by the nucleus over a few hundred years. Excess color temperatures relative to a blackbody indicate that the particles either are large enough to support a temperature gradient over their surfaces or that a small particle population exists with diameters less than 100 A. In the case of the latter, such small particles would have to have originated from the large particles, otherwise their acceleration by the gas outflow to km/s velocities would have prevented their ejection into trail orbits. GRA

N90-30154# International Centre for Theoretical Physics, Trieste (Italy).
INFORMATION LOSS DOWN A BLACK HOLE
S. C. Lee (National Univ. of Singapore.) and A. Y. Shiekh Jan. 1990 5 p
(DE90-627482; IC-90/18) Avail: NTIS (US Sales Only) HC A01/MF A01

It is found that, to an external observer, an object falling into a black hole is lost beyond any return, in a finite amount of time. DOE

N90-30155# California Univ., Berkeley. Lawrence Berkeley Lab. Nuclear Science Div.
FAST PULSARS, STRANGE STARS: AN OPPORTUNITY IN RADIO ASTRONOMY
Norman K. Glendenning 15 Jul. 1990 9 p Presented at the American Physical Society's Joint Symposium of Nuclear Physics and Astrophysics, Washington, DC, 16-18 Apr. 1990 and at the American Chemical Society's Symposium on Nuclear Astrophysics, Boston, MA, 22-27 Apr. 1990
(Contract DE-AC03-76SF-00098)
(DE90-015630; LBL-29101; CONF-900495-1; CONF-900402-8)
Avail: NTIS HC A02/MF A01

The world's data on radio pulsars is not expected to represent the underlying pulsar population because of a search bias against detection of short periods, especially below 1 ms. Yet pulsars in increasing numbers with periods right down to this limit have been discovered suggesting that there may be even shorter ones. If pulsars with periods below 1/2 ms were found, the conclusion that the confined hadronic phase of nucleons and nuclei is only metastable would be almost inescapable. The plausible ground state in that event is the deconfined phase of (3-flavor) strange-quark-matter. From the QCD energy scale this is as likely a ground state as the confined phase. We show that strange matter as the ground state is not ruled out by any known fact, and most especially not by the fact that the universe is in the confined phase. DOE

N90-30156# Los Alamos National Lab., NM. Theoretical Div.
THE IMPACT OF IUE ON STUDIES OF THE NOVA OUTBURST: 1986-1990
S. Starrfield (Arizona State Univ., Tempe.) 1990 34 p Presented at the Evolution in Astrophysics: IUE Astronomy in the Era of New Space Missions, Toulouse, France, 29 May - 1 Jun. 1990 Submitted for publication
(Contract W-7405-eng-36)
(DE90-014915; LA-UR-90-2374; CONF-9005248-4) Avail: NTIS HC A03/MF A01

In this review I will concentrate on the improvements in our understanding of the nova outburst that have occurred since the IUE meetings in London in 1986 and Goddard in 1988 and those results that have occurred as a direct result of studies with the IUE satellite. These involve the four outbursts that have occurred in the LMC, the numerous recurrent novae outbursts, and a number of archival studies. As a direct result of IUE studies done since 1986, we can now state that fast novae become super-Eddington at maximum, that many novae decline at the same rate, and that neon novae may be more numerous than thought previously. In addition, we have found that there are differences in the outburst characteristics between novae with giant secondaries and those with compact secondaries. DOE

N90-30157# European Space Agency, Paris (France).
IUE-ULDA ACCESS GUIDE NO. 2. INTERNATIONAL ULTRAVIOLET EXPLORER-UNIFORM LOW DISPERSION ARCHIVE: COMETS
Michel C. Festou, comp. (Observatoire de Besancon, France) May 1990 184 p
(ESA-SP-1134; ISBN-92-9092-112-9; ETN-90-97591) Copyright Avail: NTIS HC A09/MF A01

Background information on both low and high dispersion spectra of comets taken between Oct. 15, 1978 and Sep. 14, 1989 with the IUE is presented. Characteristics of individual exposures are given in the form of an extended version of the IUE merged log of observations including information on the geometrical factors relevant to each object and observation as well as comments about the pointing accuracy. This primary data set is re-organized in four additional tables in which the information is arranged by comet name, heliocentric and IUE-centric squared distance, and heliocentric velocity. Complementary tables give the list of high resolution spectra, that of FES (Fine Error Sensor) images and FES count rates. References of papers in which published observations and discussions of IUE observations have appeared are given. The list of comets observed with the IUE is given. The guide is illustrated by raw images, line by line spectra and both low and high dispersion spectra of comets taken with the IUE whose list is given. ESA

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N90-30158*# Virginia Univ., Charlottesville.
A LUNAR SPACE STATION
Lu Trinh, Mark Merrow, Russ Coons, Gabrielle Iezzi, Howard M. Palarz, Marc H. Nguyen, Mike Spitzer, and Sam Cubbage 1989 115 p
(Contract NASw-4435)
(NASA-CR-186223; NAS 1.26:186223) Avail: NTIS HC A06/MF A01 CSCL 13B

A concept for a space station to be placed in low lunar orbit in support of the eventual establishment of a permanent moon base is proposed. This space station would have several functions: (1) a complete support facility for the maintenance of the permanent moon base and its population; (2) an orbital docking area to facilitate the ferrying of materials and personnel to and from Earth; (3) a zero gravity factory using lunar raw materials to grow superior GaAs crystals for use in semiconductors and mass produce inexpensive fiber glass; and (4) a space garden for the benefit of the air food cycles. The mission scenario, design requirements, and technology needs and developments are included as part of the proposal. B.G.

N90-30159 Kent Univ., Canterbury (England).
DUST EMISSION BY COMET P/HALLEY 1982i Ph.D. Thesis
Sepideh Chakaveh 1989 158 p
Avail: Univ. Microfilms Order No. BRDX88054

The 1986 apparition of Comet P/Halley provided an opportunity to study the physical behavior of comets. This was achieved by targeting five spacecraft to the vicinity of Comet P/Halley. The data provided by one of the above five spacecraft, namely GIOTTO, is examined. A quantitative analysis of the dust concentration in the vicinity of Comet P/Halley's nucleus was of special interest, so that the expected duration of detection of particles by GIOTTO could be investigated. A computer model was developed to predict the spatial dust density as to be detected by GIOTTO-DIDSY experiment, and to determine the surface brightness from the dust concentration along the line of sight, allowing comparison of the model with ground-based observations. The physics and the computing techniques used to develop this model are described, and the results of this model compared with various experimental data, namely, IRAS observations of Comet P/Tempell, GIOTTO-DIDSY measurements, and CCD ground-based observations of Comet P/Halley. Dissert. Abstr.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

N90-30160# Tokyo Univ., Tanashi (Japan). Inst. for Cosmic Ray Research.
SEARCH FOR NEUTRINO EVENTS IN THE KAMIOKANDE-2 DETECTOR IN CORRELATION WITH THE SOLAR-FLARE ACTIVITY IN MARCH 1989
K. S. Hirata, T. Kajita, T. Kifune, K. Kihara, M. Nakahata, K. Nakamura, S. Ohara, N. Sato, Y. Suzuki, and Y. Totsuka et al Dec. 1989 13 p Submitted for publication
(DE90-508085; ICR-201-89-18; OULNS-89-11; KEK-Preprint-89-151; UPR-0178E) Avail: NTIS (US Sales Only) HC A03/MF A01

A search was made for neutrino events (E sub v greater than or approx. 50 MeV) in the Kamiokande-2 water Cherenkov detector in correlation with the great solar flare activity observed in March 1989. No evidence was obtained for such a correlation. Upper limits are separately given for the optical importance 4, 3, and 2 flares for both time integrated and time averaged solar flare (nu sub e) fluxes at E(sub v) = 50 MeV and 100 MeV. At E(sub v) = 100 MeV, the 90 percent confidence-level upper limit for the time integrated (nu sub e) flux per importance 4 (3) flare is 3.5 x 10(sup 7) (1.4x10(exp 7))/sq cm. Even the upper limit for the importance 4 flare is considerably lower than the (nu sub e) flux at the corresponding energy needed to explain the excess neutrino captures reported in some of the (37)Cl experimental runs when large solar flares occurred. A search was also made for low energy events (recoil e(sup (+ or -)) energy greater than or approx. 10 MeV) in correlation with importance (greater than or =) 2 flares and with the solar proton flux (greater than or =) 10 MeV. Again, no significant signal was observed. DOE

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N90-30161 California Univ., Berkeley.
A SEARCH FOR LOW ENERGY COSMIC RAY ANTIPROTONS Ph.D. Thesis
Douglas Maynard Lowder 1988 117 p
Avail: Univ. Microfilms Order No. DA8916769

In 1981, a measurement of the flux of antiprotons (bar p's) in the cosmic radiation using a calorimetric detection method reported the ratio bar p/p as (2.2 + or - 0.6) x 10(exp -4) for kinetic energies (at the top of the atmosphere) below 320 MeV; the result was two orders of magnitude higher than that predicted by conventional cosmic ray models. Many interesting mechanisms were proposed to explain the discrepancy; to fully resolve this problem, new experiments were needed. The balloon-borne detector PBAR, a magnetic spectrometer designed to identify and determine the energies of antiprotons and protons in the kinetic energy range 100 to 1500 MeV is described, and the results discussed from the successful 14-hour flight of August, 1987. PBAR, unlike previously flown spectrometers, determines directly the masses of cosmic rays by simultaneously measuring momentum and velocity. Momentum measurement is made by a fine-grained array of drift tubes, placed in the field of a superconducting magnet, that tracks the trajectory of a particle passing through, and gives the rigidity and charge sign of the particle. Velocity is determined in two ways: with a time-of-flight (TOF) measurement over the 1.5 meter distance between two planes of scintillators, and with a water Cerenkov counter for higher velocities. The measured pulse heights of a particle in the scintillators give the charge magnitude. After discussion of the previous experiments and motivation for a new measurement, a description of the instrument and each detector is given; a discussion is then made of the flight data and results. Special emphasis is placed on those aspects of the experiment in which the author played the greatest role: the design and construction of the TOF system, and the reduction and analysis of the flight data. Dissert. Abstr.

N90-30162# Royal Aerospace Establishment, Farnborough (England).
RE-ANALYSIS OF DATA ON THE SPACE RADIATION ENVIRONMENT ABOVE SOUTHEAST ASIA
P. R. Truscott Nov. 1989 57 p Original contains color illustrations
(AD-A224155; RAE-TR-89048; DRIC-BR-113987) Avail: NTIS HC A04/MF A01 CSCL 04/1

A new analysis was performed on the HRM-3 gamma ray detector data collected from Shuttle missions STS-41B, 41C, 41D, 41G, and 51A. The new analysis shows no evidence for the existence of enhanced levels of radiation in low-Earth orbit over South-East Asia (i.e., in the area bounded by longitudes 100 E to 190 E and latitudes 10 S to 15 N) as previously suggested. Variations in the detector count rates with geophysical location are shown to be consistent with the variation of the cosmic ray flux with geomagnetic latitude, and also show expected increases due to the South Atlantic Anomaly (SAA) and outer belt electrons. However, at times poor quantitative agreement is found between the expected positions of the SAS or outer electron belt, and the Shuttle's geophysical location on the occasions when high count rates were observed. It is believed that this lack of correlation is a result of the sensitivity of the trapped particle environment to geophysical position and magnetospheric activity. GRA

N90-30163# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Nuclear Engineering.
AN ADVANCED SINGLE EVENT UPSET TESTER Ph.D. Thesis Final Report
Alfred G. Costantine May 1990 104 p Sponsored by USASD, Fort Benjamin Harrison, IN
(AD-A223613) Avail: NTIS HC A06/MF A01 CSCL 20/8

Traditionally the testing of microelectronics for single event upset (SEU) sensitivity has involved actual exposure to the cosmic ray environment by high altitude flight programs or the simulation of the cosmic ray environment through the use of heavy ion beams produced by accelerators. These simulations are expensive and of limited access, thus alternatives have been sought. This research resulted in the building of a system to measure single event upset cross section versus linear energy transfer by using Cf252 fission fragments in conjunction with thin film scintillators. The first efforts to use Cf252 for SEU testing involved placing a Cf252 source in an evacuated chamber, bombarding the device under test, and calculating a single upset cross section that presumably was the saturation cross section. Such tests do not adequately address the uncertainties associated with the LET dispersion, and fail to usefully characterize the SEU threshold and saturation cross section of a device because there is no means to provide the SEU cross section versus LET curve. The system developed in this research effort addresses these shortcomings. GRA

N90-30164# Tokyo Univ. (Japan). Dept. of Physics.
DETECTOR TO STUDY LOW-FLEX HARD X RAY/GAMMA RAY SOURCES
T. Kamae, T. Takahashi, M. Tanaka, S. Gunji, S. Miyazaki, T. Tamura, Y. Sekimoto, N. Yamaoka, J. Nishimura, and N. Yajima (Tokyo Univ., Sagamihara, Japan) et al Jul. 1990 5 p Presented at the 28th COSPAR, Jul. 1990 Prepared in cooperation with National Lab. for High Energy Physics, Tsukuba (Japan); Rikkyo Univ.; Osaka City Univ.; and Inst. de Pesquisas Espaciais
(UT-HE-90/08; Paper-S-14-3-7) Avail: NTIS HC A01/MF A01

New phoswich counters were developed that will be capable of detecting low flux hard x rays/gamma rays from astronomical objects. The new phoswich counter consists of a small inorganic scintillator with a fast decay time (the detection part) glued to the interior bottom surface of a rectangular well-shaped block of another inorganic scintillator with a slow decay time (the shielding part). Here, the well-shaped shielding part acts as an active collimator as well as an active shield. A detector system was built which consists of 64 such phoswich counters: newly developed scintillator (GSO) is used for the detection part and CsI(Tl) is used for the shielding part. The total geometrical area of the 64 detection parts is about 740 sq cm and its 3 sigma sensitivity is expected to reach below 10(exp -5)/sq cm/s/keV up to 700 keV. With several improvements such detectors will be able to detect hard x rays/gamma rays at a flux level around 10(exp -6)/sq cm/s/keV up to 2 MeV. Author

N90-30165# Tokyo Univ. (Japan). Dept. of Physics.
NEW DEVELOPMENTS IN LOW-ENERGY COSMIC GAMMA-RAY DETECTION
T. Kamae Jul. 1990 11 p Presented at the 28th COSPAR

Meeting, Jul. 1990
(UT-HE-90/07; Paper-ME-4-1-4) Avail: NTIS HC A03/MF A01

Recent developments in detector technologies applicable to low-energy gamma-ray detection are reviewed. Emphasis is given to the silicon technologies now being developed around particle physics laboratories, which are expected to lay basis for new generation low-energy cosmic gamma-ray detectors. Author

N90-30166# Royal Aerospace Establishment, Farnborough (England).
RE-ANALYSIS OF DATA ON THE SPACE RADIATION ENVIRONMENT ABOVE SOUTH-EAST ASIA
P. R. Truscott 8 Nov. 1989 63 p Original contains color illustrations
(RAE-TR-89048; RAE-Space-677; BR113987; ETN-90-97603)
Copyright Avail: NTIS HC A04/MF A01

A new analysis was performed on the hand held HRM 3 gamma ray detector data collected from Shuttle missions STS-41B, 41C, 41D, 41G, and 51A. The new analysis shows no evidence for the existence of enhanced levels of radiation in low Earth orbit over South East Asia (i.e., in the area bounded by longitudes 100 to 190 deg east and latitudes 10 deg south to 15 deg north) as previously suggested. Variation in the detector count rates with geographical location are shown to be consistent with the variation of the cosmic ray flux with geomagnetic latitude, and also show expected increases due to the South Atlantic Anomaly (SAA) and outer belt electrons. However, at times poor quantitative agreement is found between the expected positions of the SAA or outer electron belt, and the Shuttle's geographical location on the occasions when high count rates were observed. It is believed that this lack of correlation is a result of the sensitivity of the trapped particle environment to geographical position and magnetospheric activity. ESA

99 GENERAL

N90-30167*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A GUIDE TO THE NATIONAL SPACE SCIENCE DATA CENTER
Washington Jun. 1990 76 p
(NASA-TM-89637; NAS 1.15:89637; NSSDC-90-07) Avail: NTIS HC A05/MF A01 CSCL 05A

This is the second edition of a document that was published to acquaint space and Earth research scientists with an overview of the services offered by the NSSDC. As previously stated, the NSSDC was established by NASA to be the long term archive for data from its space missions. However, the NSSDC has evolved into an organization that provides a multitude of services for scientists throughout the world. Brief articles are presented which discuss these services. At the end of each article is the name, address, and telephone number of the person to contact for additional information. Online Information and Data Systems, Electronic Access, Offline Data Archive, Value Added Services, Mass Storage Activities, and Computer Science Research are all detailed. E.R.

N90-30168# European Space Agency, Paris (France).
SOME PERSONAL REMINISCENCES. THE ESRO-ESA SPACE SCIENCE STORY: TWENTY-FIVE YEARS OF EUROPEAN COOPERATION
Norman Longdon, ed. Jun. 1990 41 p Original contains color illustrations
(ESA-BR-66; ISBN-92-9092-043-2; ISSN-0250-1589; ETN-90-97595) Copyright Avail: NTIS HC A03/MF A01; EPD, ESTEC, Noordwijk, The Netherlands, HC 20 Dutch guilders

European cooperation is discussed with reference to research into space science, including Sun-Earth relation, atmosphere, galactic and extragalactic astronomy and astrophysics and exploration of the solar system. The EPONA (Energetic Particle Onset Admonitor) instrument on the Giotto mission and the birth of the Hipparcos mission are remembered. The building of Horizon 2000 program and early days of service in ESRO are discussed. Memories relating to a certain time, including the Ulysses spacecraft and Hubble Space Telescope are presented. ESA

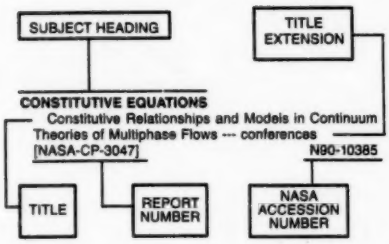
N90-30169# European Space Agency, Paris (France).
[ACTIVITIES REPORT OF THE EUROPEAN SPACE AGENCY] Annual Report, 1989
Norman Longdon, ed. and James Hunt, ed. May 1990 236 p Original contains color illustrations
(ISSN-0258-025X; ETN-90-97599) Copyright Avail: NTIS HC A11/MF A02

The development program and basic activities, installations and administration are reviewed. Programs covered include: scientific, Earth observation, microgravity, telecommunications, space transportation and space stations and platforms. Activities relating to technological research and development, scientific research, satellite operations and data handling and archiving are covered. Installations include ground facilities for space systems, test facilities, and ESA establishments. The organization and structure, finance and contracts and commercialization, and external relations are discussed. ESA

N90-30170# Southampton Univ. (England). Inst. of Sound and Vibration Research.
[ACTIVITIES REPORT OF THE INSTITUTE OF SOUND AND VIBRATION RESEARCH] Annual Report, 1990
1990 52 p
(ETN-90-97604) Avail: NTIS HC A04/MF A01

Research, project lists, publication lists are presented for the following groups: fluids dynamics and acoustics; audiology and human effects; structures and machinery; signal processing and control; consultancy. Degree courses and continuing education are described. ESA

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7064).

A

ABILITIES
Ability and metacognitive determinants of skill acquisition and transfer
[AD-A224569] N90-29776

ABSORBERS (MATERIALS)
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber
[NAL-TM-603] N90-30030

ABSORPTION COOLING
A cost-effective realization of environmental temperature control
[DE90-011651] N90-29532

ABSORPTION SPECTRA
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29718

ABSTRACTS
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989
[AD-A224256] N90-29299
Proceedings of the 45th Ohio State University Symposium on Molecular Spectroscopy
[AD-A224349] N90-29457
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-004] N90-29688
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-003] N90-29689
JPRS Report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-007] N90-29762
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-004] N90-29763
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124

ABUNDANCE
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151

ACCELERATION (PHYSICS)
Application of a rechargeable, small caliber railgun power supply
[AD-A224207] N90-29418
Prospects for nuclear astrophysics with intense radioactive ion beams
[DE90-015616] N90-30044

ACCEPTABILITY
SONA: A measurement system for the determination of the end-of-flight burst behaviour of projectiles equipped with proximity fuses
[FEL-89-A293] N90-29536

ACCESS CONTROL
Parallel architectures and algorithms for image understanding
[AD-A223479] N90-29940

ACCUMULATIONS
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765

ACCUMULATORS
Heavy Nucleus Collector (HNC) project for the NASA Long Duration Exposure Facility (LDEF)
[NASA-CR-182094] N90-30045

ACCURACY
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460

ACOUSTIC ATTENUATION
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber
[NAL-TM-603] N90-30030

ACOUSTIC DUCTS
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber
[NAL-TM-603] N90-30030

ACOUSTIC EXCITATION
Investigation of a heat driven thermoacoustic prime mover
[AD-A223928] N90-29694

ACOUSTIC IMPEDANCE
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619

ACOUSTIC MEASUREMENT
SONA: A measurement system for the determination of the end-of-flight burst behaviour of projectiles equipped with proximity fuses
[FEL-89-A293] N90-29536
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619

ACOUSTIC VELOCITY
Nondestructive material characterization
[DE90-015176] N90-29652
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033

ACOUSTICS
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
Activities report of the Institute of Sound and Vibration Research
[ETN-90-97604] N90-30170

ACOUSTO-OPTICS
A compact real-time acousto-optic image correlator
[DE90-015564] N90-30054

ACRYLIC ACID
Shear-resistant drag reduction polymers. Part 1: Molecular investigations of polymer drag reduction and the development of laboratory screening methods
[AD-A223353] N90-29508

ACRYLIC RESINS
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503

ACRYLONITRILES
Toughening of SAN copolymers by an SAN emulsion grafted rubber
[AD-A224213] N90-29502

ACTIVE CONTROL
Distributed control architecture for CNI preprocessors N90-29356
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
Real-time cartesian force feedback control of a teleoperated robot N90-29857
A distributed control and monitor system used in laser fusion research
[DE90-011483] N90-30078

ACTUATORS
Procedure for calibrating fly-by-wire control chains of the flying testbed ATTAS
[DLR-MITT-90-02] N90-29401
Time optimal movement of cooperating robots N90-29815

ADA (PROGRAMMING LANGUAGE)
Issues in expanding the software base management system supporting the Computer Aided Prototyping System (CAPS)
[AD-A224344] N90-29933
The effect of software reusability on information theory based software metrics
[AD-A224472] N90-29936
An Ada-based marine radar simulator for collision avoidance training
[ETN-90-97611] N90-29970

ADAPTIVE CONTROL
Adaptive control of an arc welding process
[AD-A223626] N90-29645
An improved adaptive control for repetitive motion of robots N90-29831
Direct adaptive control of a PUMA 560 industrial robot N90-29832
On discrete control of nonlinear systems with applications to robotics N90-29893
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953
Optimal control law phenomena in certain adaptive second-order observation systems
[AD-A224274] N90-29986

ADHESION
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517

ADHESIVE BONDING
Aircraft battle damage repair of transparencies
[AD-A224168] N90-29387

ADIABATIC EQUATIONS
Adiabatic invariance and transient resonance in very slowly varying oscillatory Hamiltonian systems
[DE90-016118] N90-30007

ADJOINTS
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437

ADVECTION
A parallel least squares collocation conjugate gradient approach for the advection diffusion equation
[DE90-015965] N90-29961

AERIAL RECONNAISSANCE
Airborne target detection, acquisition, and tracking devices
[AD-A223852] N90-29555
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739

AEROACOUSTICS
Cavity aeroacoustics
[AD-A223853] N90-29307

Generalized Advanced Propeller Analysis System (GAPAS). Volume 2: Computer program user manual
[NASA-CR-185277] N90-29394
AEROASSIST
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300
Optimal trajectories for hypervelocity flight
N90-29378
Design and evaluation of candidate pressure distribution and air data system tile penetration for the aeroassist flight experiment
[NASA-CR-4312] N90-29615
AERODYNAMIC CHARACTERISTICS
Transonic 3-D Euler analysis of flows around tanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform
[NASA-CR-186226] N90-29381
Fighter agility metrics
[NASA-CR-187289] N90-29389
Generalized Advanced Propeller Analysis System (GAPAS). Volume 2: Computer program user manual
[NASA-CR-185277] N90-29394
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587
The experimental investigation of flow in the core of a vortex structure
[BR114893] N90-29597
AERODYNAMIC COEFFICIENTS
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
AERODYNAMIC CONFIGURATIONS
Dynamic separation: Search for the cause of dynamic stall and search for its control
[AD-A223412] N90-29305
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
AERODYNAMIC DRAG
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300
AERODYNAMIC FORCES
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
Windshear estimation along the trajectory of an aircraft N90-29745
AERODYNAMIC HEAT TRANSFER
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
AERODYNAMIC LOADS
The Second ARO Workshop on Rotorcraft Interactional Aerodynamics
[AD-A223310] N90-29304
Analysis of dynamic transient response and postflutter behavior of super-maneuvering airplane
[AD-A224126] N90-29386
AERODYNAMIC STALLING
Dynamic separation: Search for the cause of dynamic stall and search for its control
[AD-A223412] N90-29305
AERODYNAMICS
Comparison of wind tunnel airfoil performance data with wind turbine blade data
[DE90-000343] N90-29308
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1046] N90-29326
Some topics in computational transonic aerodynamics: Revision
[NAL-TR-1018T] N90-29332
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform
[NASA-CR-186226] N90-29381
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
AEROELASTICITY
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402
AEROSOLS
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
Submicron particle analyzer
[AD-A223558] N90-30050
AEROSPACE ENGINEERING
Control and estimation for aerospace applications with system time delays N90-29357
Workshop on Low Level Flight Training
[AGARD-AR-288] N90-29404
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735
NASA authorization, 1991, volume 2
[GPO-32-196] N90-30138
AEROSPACE ENVIRONMENTS
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
AEROSPACE INDUSTRY
A package for 3-D unstructured grid generation, finite-element flow solution and flow field visualization
[NASA-CR-182090] N90-29309
AEROSPACE PLANES
Optimal trajectories for hypervelocity flight
N90-29378
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
A collision avoidance system for a spaceplane manipulator arm N90-29903
AEROSPACE SCIENCES
Activities report of the Space Science Department
[ESA-SP-1125] N90-30142
AEROSPACE SYSTEMS
External information sources and aerospace R/D: The use and importance of technical reports by US Aerospace engineers and scientists
[NASA-TM-101232] N90-30132
AEROTHERMODYNAMICS
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE)
[NAL-TR-1028] N90-29330
AIR
Oxygen deficiency monitor system
[DE90-014866] N90-29917
AIR DATA SYSTEMS
Design and evaluation of candidate pressure distribution and air data system tile penetration for the aeroassist flight experiment
[NASA-CR-4312] N90-29615
AIR JETS
Particle dispersion in a turbulent shear flow
[AD-A224327] N90-29590
AIR LAND INTERACTIONS
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710
AIR NAVIGATION
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
GPS integrity requirements for use by civil aviation
N90-29339
Combining LORAN and GPS: The best of both worlds
N90-29343
Techniques for autonomous GPS integrity monitoring
N90-29345
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350
AIR POLLUTION
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-208588] N90-29701
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
Effects of increased CO2 on forest response
[DE90-015408] N90-29708
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712
AIR QUALITY
The Surface Air Sampling Program
[DE90-014873] N90-29711
AIR SAMPLING
The Surface Air Sampling Program
[DE90-014873] N90-29711
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712
AIR TRAFFIC
Communications Interface Driver (CID) software principles of operation
[DOT/FAA/CT-TN89/46] N90-29937
AIR TRAFFIC CONTROL
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
Study improvement training facilities ground control air traffic controllers. Part 1: Alternative solutions and their consequences
[FEL-89-A257-PT-1] N90-29380
Study improvement training facilities ground control air traffic controllers. Part 2: Functional analysis approach control trainer
[FEL-89-A280-PT-2] N90-29409
AIR TRAFFIC CONTROLLERS (PERSONNEL)
Study improvement training facilities ground control air traffic controllers. Part 2: Functional analysis approach control trainer
[FEL-89-A280-PT-2] N90-29409
Ability and metacognitive determinants of skill acquisition and transfer
[AD-A224569] N90-29776
AIR TRANSPORTATION
The cost of air service fragmentation
[TT-9010] N90-29334
AIR WATER INTERACTIONS
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
AIRBORNE EQUIPMENT
Characteristics of pushbroom scanning type radiometer utilizing linear sensors
[NAL-TR-1024] N90-29625
AIRCRAFT ACCIDENT INVESTIGATION
UK airmisses involving commercial air transport: May - August 1989
[ISSN-0951-6301] N90-29335
AIRCRAFT COMPARTMENTS
Tests for aircraft interior materials in fire accident
[LR-622] N90-29337
AIRCRAFT CONFIGURATIONS
Aircraft evacuations: The effect of passenger motivation and cabin configuration adjacent to the exit
[CAA-PAPER-89019] N90-29336
AIRCRAFT CONSTRUCTION MATERIALS
Tests for aircraft interior materials in fire accident
[LR-622] N90-29337
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683
AIRCRAFT CONTROL
Evaluation for DLC-Flap Monitoring System of the VSRA
[NAL-TM-607] N90-29391
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399
AIRCRAFT DESIGN
Some topics in computational transonic aerodynamics: Revision
[NAL-TR-1018T] N90-29332
Aircraft evacuations: The effect of passenger motivation and cabin configuration adjacent to the exit
[CAA-PAPER-89019] N90-29336
Aircraft design for mission performance using nonlinear multiobjective optimization methods
[NASA-CR-4328] N90-29384

WingDesign: Program for the structural design of a wing cross-section
[LR-627] N90-29390
A human factors engineering approach to the development and dynamic evaluation of a prototype aircrew seat for military aircraft
[AD-A218283] N90-29779

AIRCRAFT ENGINES
Audibility and annoyance of en route noise of unducted fan engines
[AD-A223687] N90-30035

AIRCRAFT LANDING
Electro-optics engineering support for the integrated launch and recovery television surveillance system
[AD-A223450] N90-29406

AIRCRAFT MANEUVERS
Observability of relative navigation using range-only measurements N90-29360
Analysis of dynamic transient response and postflutter behavior of super-maneuvering airplane
[AD-A224126] N90-29386
Fighter agility metrics
[NASA-CR-187289] N90-29389

AIRCRAFT NOISE
Audibility and annoyance of en route noise of unducted fan engines
[AD-A223687] N90-30035
Assessment System for Aircraft Noise (ASAN): Development of alpha-test prototype system software
[AD-A223770] N90-30036

AIRCRAFT PERFORMANCE
Survivable penetration N90-29363
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385

AIRCRAFT RELIABILITY
Tests for aircraft interior materials in fire accident
[LR-622] N90-29337
Application of multifunction inertial reference systems to fighter aircraft N90-29341

AIRCRAFT STABILITY
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform
[NASA-CR-186226] N90-29381

AIRCRAFT STRUCTURES
Aircraft battle damage repair of transparencies
[AD-A224168] N90-29387
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683

AIRCRAFT SURVIVABILITY
Survivable penetration N90-29363

AIRCRAFT TIRES
Reliability and performance of friction measuring tires and friction equipment correlation
[AD-A223694] N90-29408

AIRFOIL PROFILES
WingDesign: Program for the structural design of a wing cross-section
[LR-627] N90-29390

AIRFOILS
Comparison of wind tunnel airfoil performance data with wind turbine blade data
[DE90-000343] N90-29308
A boundary-layer transition model for the Navier-Stokes computation for a natural-laminar-flow airfoil
[NAL-TR-1038T] N90-29328
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031

AIRFRAME MATERIALS
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480

AIRFRAMES
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap
[NAL-TR-1047] N90-29686

AIRLINE OPERATIONS
Airline productivity relating on the fuel cost. (2): Fuel consumption values and fuel efficiency
[NAL-TM-604-2] N90-29333

AIRPORT PLANNING
The potential for an extra runway at Heathrow: A preliminary feasibility study
[TT-9007] N90-29403

AIRPORTS
The cost of air service fragmentation
[TT-9010] N90-29334
The potential for an extra runway at Heathrow: A preliminary feasibility study
[TT-9007] N90-29403

AIRSPACE
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350

ALGEBRA
The control point form of algebraic grid generation N90-29609
Trees, bialgebras and intrinsic numerical algorithms
[NASA-CR-187031] N90-29925
An algebraic hierarchical basis preconditioner
[DE90-015875] N90-30008

ALGOL
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143

ALGORITHMS
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364
Omega navigation signal characteristics N90-29369
A land navigation demonstration vehicle with a color map display for tactical use N90-29375
Optimal trajectories for hypervelocity flight N90-29378
AutoPAVER: A software package for automated pavement evaluation
[AD-A224176] N90-29531
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies
[AD-A224358] N90-29539
High range resolution radar cross-section profiles: A preliminary analysis
[AD-A223448] N90-29550
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
Macro cell placement with neural net algorithms
[REPT-90-020] N90-29585
Unstructured mesh methods for CFD N90-29611
A vector diagram approach to shaping inputs for vibration reduction
[AD-A223724] N90-29671
Active vibration damping of flexible structures
[DLR-FB-90-03] N90-29676
Studies of ionospheric dynamics utilizing data from DMSP
[AD-A223370] N90-29733
Windshear estimation along the trajectory of an aircraft N90-29745
Guidance algorithms for a free-flying space robot N90-29798
Trinocular stereovision using figural continuity, dealing with curved objects N90-29802
A fast 3-D object recognition algorithm for the vision system of a special-purpose dexterous manipulator N90-29803
THREAD: A programming environment for interactive planning-level robotics applications N90-29810
What kind of computation is intelligence. A framework for integrating different kinds of expertise N90-29817
The flight telerobotic servicer: From functional architecture to computer architecture N90-29823
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
Test and validation for robot arm control dynamics simulation N90-29826
Discrete-time adaptive control of robot manipulators N90-29834
Optimal payload rate limit algorithm for zero-G manipulators N90-29858
Efficient conjugate gradient algorithms for computation of the manipulator forward dynamics N90-29864
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877
Trees, bialgebras and intrinsic numerical algorithms
[NASA-CR-187031] N90-29925
The development and evaluation of numerical algorithms for MIMD computers
[NASA-TM-101167] N90-29939
Parallel architectures and algorithms for image understanding
[AD-A223479] N90-29940
A comparison of hardware implementations for low-level vision algorithms
[AD-A223699] N90-29945
Fast algorithms for parallel architectures
[AD-A223731] N90-29947
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
Developing tools for performance visualization of parallel algorithms
[DE90-015801] N90-29960
Handbook of data compression algorithms
[ESA-TM-06] N90-29969
Unstructured mesh relaxation
[DE90-015614] N90-29989
The location of zeros using generalizations of Newton's method
[DE90-627166] N90-30023
A canonical integration technique of arbitrary order
[DE90-628377] N90-30025
Monte Carlo simulation of complex spectra for opacity calculations
[DE90-015198] N90-30147

ALIGNMENT
Kalman filter formulations for transfer alignment of strapdown inertial units N90-29342
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372

ALKANES
Novel macrocyclic carriers for proton-coupled liquid membrane transport
[DE90-015529] N90-29453

ALL-WEATHER AIR NAVIGATION
The integration of multiple avionic sensors and technologies for future military helicopters N90-29344

ALOUETTE 1 SATELLITE
Results from Alouette 1, Explorer 20, Alouette 2, and Explorer 31
[NASA-TM-101822] N90-29690

ALOUETTE 2 SATELLITE
Results from Alouette 1, Explorer 20, Alouette 2, and Explorer 31
[NASA-TM-101822] N90-29690

ALPHA PARTICLES
Emission of quick neutrons and non-equilibrium phenomena by central shocks in the reaction 40 Ar + 40 Ca at 20 MeV/u
[ETN-90-97296] N90-30043
Control of helium accumulation
[DE90-015658] N90-30084

ALTERNATING CURRENT
Performance test plan for variable-speed ac superconducting motor
[DE90-016208] N90-29579

ALTITUDE TESTS
High altitude balloon flight test of the GRAD experiment
[AD-A224398] N90-29388

ALUMINIDES
Powder processing of aluminides
[DE90-015314] N90-29447

ALUMINUM ALLOYS
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443
Processability and high temperature behavior of emerging aerospace alloys
[AD-A224285] N90-29475
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480
Oxidation of NiAl(110)
[DE90-015645] N90-29487
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499

ALUMINUM COMPOUNDS
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105

ALUMINUM GALLIUM ARSENIDES
Manufacturing and characterization of liquid-phase epitaxy layers with atomic levels at the crystal surface and at the hetero limit surfaces in the system GaAs-AlGaAs
[ETN-90-97310] N90-30113

ALUMINUM OXIDES
Non-destructive evaluation of infiltration-toughened ceramics
[DE90-629716] N90-29501

AMBIENT TEMPERATURE
A cost-effective realization of environmental temperature control
[DE90-011651] N90-29532

AMPLITUDES
Introductory lectures on conformal field theory and strings
[DE90-627219] N90-30120
ANALYSIS OF VARIANCE
A new diagnostics approach for repeated measures designs
[AD-A223500] N90-30020
ANALYTIC FUNCTIONS
Some overdetermined systems of complex partial differential equations
[DE90-627162] N90-29995
ANALYZERS
GSHELL: Multichannel analyzer/multichannel scaler emulation software for IBM-PC-compatible computers
[DE90-015396] N90-29956
Submicron particle analyzer
[AD-A223558] N90-30050
ANGULAR ACCELERATION
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399
ANGULAR CORRELATION
The effects on antenna-filtered scintillation parameters of non-zero antenna pointing angles
[AD-A223840] N90-29554
ANISOTROPIC SHELLS
Buckling of anisotropic cylindrical shells subjected to combined axial compression, normal pressure, bending and shear loading
[LR-611] N90-29678
ANISOTROPY
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443
Ionospheric irregularities: Source, structure, plasma processes and effects on sensor systems
[AD-A223908] N90-29723
Superconductivity and information exchange
[DE90-015767] N90-30110
ANNEALING
Research on mercury cadmium telluride
[AD-A224250] N90-29474
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098
ANNUAL VARIATIONS
An observational study of the circulation in the Southern Hemisphere stratosphere N90-29715
ANODIC COATINGS
Research on mercury cadmium telluride
[AD-A224250] N90-29474
ANOMALIES
Omega navigation signal characteristics N90-29389
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies
[AD-A224358] N90-29539
ANTENNA ARRAYS
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372
ANTENNA COMPONENTS
Analysis and design of modifications for improved performance of the AFIT radar cross section measurement chamber
[AD-A223352] N90-29545
ANTENNAS
Activities of the Division of Microwave Technology
[FOA-C-30555-3.2] N90-29537
The effects on antenna-filtered scintillation parameters of non-zero antenna pointing angles
[AD-A223840] N90-29554
ANTIAIRCRAFT MISSILES
Investigation method for AA-proximity fuses
[FEL-89-A194] N90-29535
ANTIPROTONS
A search for low energy cosmic ray antiprotons N90-30161
ANTISUBMARINE WARFARE
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
APERTURES
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29568
APPLICATIONS PROGRAMS (COMPUTERS)
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437
Development of a software package for automatic data acquisition, analysis, and controls in an axial flow compressor test rig
[PD-PR-8910] N90-29926
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954
ESTEC software catalogue
[ESA-SP-1133] N90-29968
APPROACH CONTROL
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364
APPROPRIATIONS
NASA authorization, 1991, volume 2
[GPO-32-196] N90-30138
APPROXIMATION
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
Approximate equations for heat conduction in multi-layered cylindrical shells
[NAL-TR-1049] N90-29614
Systems reliability and inference: Summary of accomplishments 1988-1990
[AD-A224433] N90-29653
Estimation and representation of multidimensional mappings
[DLR-MITT-90-06] N90-29967
Machine learning
[AD-A223732] N90-29988
Saddlepoint approximations in conditional inference
[AD-A223280] N90-30000
A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
ARC HEATING
Studies of surface heat transfer in an arc-heated wind tunnel
[NAL-TR-1048] N90-29410
ARC WELDING
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
The dc arc weld starter
[DE90-014679] N90-29641
Adaptive control of an arc welding process
[AD-A223626] N90-29645
ARCHITECTURE (COMPUTERS)
Distributed control architecture for CNI preprocessors N90-29356
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
High speed bus technology development
[AD-A224486] N90-29565
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
Concept for a reference model Architecture for Real-Time Intelligent Control Systems (ARTICS)
[PB90-220286] N90-29638
Controlling multiple manipulators using RIPS N90-29814
The flight telerobotic servicer: From functional architecture to computer architecture N90-29823
System architectures for telerobotic research N90-29872
Optical symbolic processor for expert system execution
[AD-A224284] N90-29931
Parallel architectures and algorithms for image understanding
[AD-A223479] N90-29940
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
Fast algorithms for parallel architectures
[AD-A223731] N90-29947
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953
GSHELL: Multichannel analyzer/multichannel scaler emulation software for IBM-PC-compatible computers
[DE90-015396] N90-29956
A manual for microcomputer image analysis
[DE90-015629] N90-29958
Asynchronous design for parallel processing architectures
[AD-A223754] N90-29981
Approach to telerobot computing architecture
[NASA-CR-186993] N90-29984
Optical signal computing
[AD-A223624] N90-30051
A survey of object-oriented database technology
[AD-A224490] N90-30130
Small multipurpose stored data acquisition system
[DE90-010823] N90-30134
Integration of information systems components
[DE90-011761] N90-30136
ARCTIC REGIONS
An integrated system for land navigation N90-29377
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
ARGON
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
ARMED FORCES (UNITED STATES)
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770
Software development: A product life-cycle perspective
[AD-A223783] N90-29952
ARRAYS
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
Symmetrical layered thin film edge field-emitter-array and method for its production
[AD-D014594] N90-29569
ARTIFICIAL INTELLIGENCE
Concept for a reference model Architecture for Real-Time Intelligent Control Systems (ARTICS)
[PB90-220286] N90-29638
Robots, systems, and flexible automation
[DE90-015802] N90-29649
Neural nets and eddy-current testing
[DE90-016044] N90-29656
Guidance algorithms for a free-flying space robot N90-29798
Reflections on the relationship between artificial intelligence and operations research N90-29816
What kind of computation is intelligence. A framework for integrating different kinds of expertise N90-29817
A design strategy for autonomous systems N90-29818
Learning in tele-autonomous systems using Soar N90-29819
Information management in an integrated space telerobot N90-29846
Global models: Robot sensing, control, and sensory-motor skills N90-29849
A layered abduction model of perception: Integrating bottom-up and top-down processing in a multi-sense agent N90-29851
Determining robot actions for tasks requiring sensor interaction N90-29868
The laboratory telerobotic manipulator program N90-29869
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29891
Strategies for tutoring multiple bugs
[AD-A223921] N90-29927
Tutorial on using LISP object-oriented programming for blackboards: Solving the radar tracking problem
[AD-A224272] N90-29930
Knowledge base refinement as improving an incorrect and incomplete domain theory
[AD-A224441] N90-29935
Machine recognition as representation and search
[AD-A223700] N90-29946
Direct estimation of structure and motion from multiple frames
[AD-A223903] N90-29985
Machine learning
[AD-A223732] N90-29988
Optical signal computing
[AD-A223624] N90-30051
ASPECT RATIO
Magnetic surfaces in tokamaks
[DE90-628905] N90-30076
ASSEMBLER ROUTINES
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
Assembler for a parallel computer
[NAL-TM-586] N90-29974
ASSEMBLY
Assembly of objects with not fully predefined shapes N90-29859
Precedence relationship representations of mechanical assembly sequences N90-29866
Using multiple sensors for printed circuit board insertion N90-29867
ASSESSMENTS
The nuclear battery
[DE90-630400] N90-29559

Techniques for developing a system safety risk assessment model
[AD-A223477] N90-29654
ASSIMILATION
The effect of wave data assimilation on the numerical simulation of wave energy advection
[KNMI-TR-121] N90-29760
ASTRONOMY
Theoretical specifications of the trajectory estimation for a space navigation system with the function of guidance and control
[NAL-TR-1032] N90-29420
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
ASTROPHYSICS
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Activities report of the Space Science Department
[ESA-SP-1126] N90-30142
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
ASYMPTOTIC PROPERTIES
Asymptotic code vector density in topographic vector quantisers
[RSRE-MEMO-4392] N90-30012
ASYMPTOTIC SERIES
Tail and quantile estimation for strongly mixing stationary sequences
[AD-A223472] N90-30019
Propagation of chaos and the McKean-Vlasov equation in duals of nuclear spaces
[AD-A224431] N90-30039
ATMOSPHERIC BOUNDARY LAYER
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
ATMOSPHERIC CHEMISTRY
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
Interstellar magnetic fields: An observational perspective N90-30144
ATMOSPHERIC CIRCULATION
An observational study of the circulation in the Southern Hemisphere stratosphere N90-29715
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29718
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146
ATMOSPHERIC COMPOSITION
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-208588] N90-29701
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
Effects of increased CO2 on forest response
[DE90-015406] N90-29708
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710
The effects of a doubling of atmospheric CO2 on the stormtracks in the climate of a general circulation model
[KNMI-WR-90-01] N90-29713
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
Oxygen deficiency monitor system
[DE90-014866] N90-29917
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
ATMOSPHERIC CORRECTION
The skin temperature of mountain slopes and the determination of the sensible heat flux
[DLR-FB-90-07] N90-29754
ATMOSPHERIC DENSITY
Atmospheric structure and variability
[AD-A223439] N90-29734
ATMOSPHERIC ELECTRICITY
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
ATMOSPHERIC GENERAL CIRCULATION MODELS
The effects of a doubling of atmospheric CO2 on the stormtracks in the climate of a general circulation model
[KNMI-WR-90-01] N90-29713
ATMOSPHERIC HEATING
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29718
ATMOSPHERIC MODELS
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710
Geophysical turbulence research at NCAR
[AD-A223361] N90-29732
Atmospheric structure and variability
[AD-A223439] N90-29734
Numerical simulation of the lightning return stroke N90-29743
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
Tests of initialization procedures with the NRL limited area numerical weather prediction model
[AD-A223549] N90-29750
Coordination of mesoscale meteorological research between ASL and European groups
[AD-A223811] N90-29751
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151
ATMOSPHERIC MOISTURE
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
A documentation of icing-relevant cloud physical parameters on vertical soundings of stratiform clouds
[DLR-MITT-90-07] N90-29753
ATMOSPHERIC PHYSICS
Tests of initialization procedures with the NRL limited area numerical weather prediction model
[AD-A223549] N90-29750
ATMOSPHERIC PRESSURE
Improved meteorological measurements from buoys and ships (IMET): Preliminary report on barometric pressure sensors
[PB90-242116] N90-29748
ATMOSPHERIC SOUNDING
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
A documentation of icing-relevant cloud physical parameters on vertical soundings of stratiform clouds
[DLR-MITT-90-07] N90-29753
ATMOSPHERIC TEMPERATURE
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
ATMOSPHERIC TIDES
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29718
ATMOSPHERIC TURBULENCE
Geophysical turbulence research at NCAR
[AD-A223361] N90-29732
ATMOSPHERICS
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
ATOMIC ENERGY LEVELS
Microscopic aspects of the initial stages of epitaxial growth. A scanning tunneling microscopy study
[AD-A224325] N90-30094
ATOMIC STRUCTURE
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460
Thermochemical data for silicon-containing species from ab initio electronic structure calculations
[DE90-011024] N90-29463
Oxidation of NiAl(110)
[DE90-015645] N90-29487
Atomistic studies of grain boundaries in alloys and compounds
[DE90-012401] N90-29492
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095
Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102
A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
ATTACK AIRCRAFT
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
ATTENTION
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224580] N90-29775
ATTITUDE CONTROL
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399
A new momentum management controller for the space station
[NASA-CR-187265] N90-29425
The control of space manipulators subject to spacecraft attitude control saturation limits N90-29871
ATTITUDE STABILITY
A three axis attitude control of a satellite
[NASDA-TR-22] N90-29421
AURORAL ARCS
Ionospheric irregularities: Source, structure, plasma processes and effects on sensor systems
[AD-A223908] N90-29723
AUSTENITE
Single-phase solidification during rapid resolidification of stainless steel alloys
[DE90-015190] N90-29483
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485
Isotopic tailoring and other techniques used to study helium effects in austenitic alloys
[DE90-016344] N90-29495
AUSTENITIC STAINLESS STEELS
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
AUTOMATIC CONTROL
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
AUTOMOBILES
Satellite navigation systems for land vehicles N90-29376
AUTONOMOUS NAVIGATION
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
AUTONOMY
Techniques for autonomous GPS integrity monitoring N90-29345
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794
A design strategy for autonomous systems N90-29818
The flight telerobotic servicer project: A technical overview N90-29821
Sensor-based fine telemanipulation for space robotics N90-29841
Teleoperation experiments with a Utah/MIT hand and a VPL DataGlove N90-29883
Instruction dialogues: Teaching new skills to a robot N90-29884
Multi-level manual and autonomous control superposition for intelligent telerobot N90-29888
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
Computed torque control of a free-flying cooperating-arm robot N90-29898
Next generation space robot N90-29899

AUTOREGRESSIVE PROCESSES
Tail and quantile estimation for strongly mixing stationary sequences
[AD-A223472] N90-30019
AUXILIARY POWER SOURCES
Thermal analyses of power subsystem components
[NASA-CR-186314] N90-29637
AVALANCHE DIODES
High voltage picosecond pulse generation using avalanche diodes
[DE90-015194] N90-29577
AVIONICS
The integration of multiple avionic sensors and technologies for future military helicopters N90-29344
Distributed control architecture for CNI preprocessors N90-29356
Integrated strapdown avionics for precision guided vehicles N90-29361
Integrated navigation/flight control for future high performance aircraft N90-29362
Survivable penetration N90-29363
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
High speed bus technology development
[AD-A224486] N90-29565
AXIAL COMPRESSION LOADS
Recent developments in shell stability analysis
[LR-633] N90-29685
AXISYMMETRIC FLOW
Structure in the near field of the transverse jet
[AD-A224502] N90-29591

B

BACKGROUND RADIATION
Microwave background distortions from domain walls
[NASA-CR-187272] N90-29556
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
BACKSCATTERING
Radar clutter via ray methods
[AD-A223796] N90-29553
BALL BEARINGS
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651
BALLISTICS
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443
BALLOON SOUNDING
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29728
BALLOON-BORNE INSTRUMENTS
High altitude balloon flight test of the GRAD experiment
[AD-A224398] N90-29388
BALMER SERIES
Formation of hydrogen line and continuum emission in young stellar objects N90-30150
BANACH SPACE
For the definition of two person zero sum games
[ETN-90-97294] N90-30022
BARIUM COMPOUNDS
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015837] N90-30108
BARIUM OXIDES
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102
BARIUM TITANATES
Image amplification in photoreactive crystals and utilization in optical reaction systems
[ETN-90-97285] N90-30059
BAROMETERS
Improved meteorological measurements from buoys and ships (IMET): Preliminary report on barometric pressure sensors
[PB90-242116] N90-29748
BAROTROPISM
Barotropic mechanisms associated with tropical plume formation N90-29719
BASE FLOW
Direct numerical simulation of turbulent couette flow
[AD-A224287] N90-29589
BAYES THEOREM
Systems reliability and inference: Summary of accomplishments 1988-1990
[AD-A224433] N90-29653
Classical and Bayes-P subset selection procedures for double exponential populations
[AD-A223830] N90-30006
BEADS
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
BEAM INTERACTIONS
Overview of advanced fuel fusion
[DE90-015660] N90-30085
BEAMS (RADIATION)
High average power CW FELS (Free Electron Laser) for application to plasma heating: Designs and experiments
[DE90-011085] N90-29633
Special purpose spatial light modulators
[AD-A223794] N90-30052
Beam and plasma physics research
[AD-A224452] N90-30067
BEAMS (SUPPORTS)
Tip-position control of a flexible beam: Modeling approaches and experimental verification
[AD-A224249] N90-29643
BEND TESTS
Surface effect for test piece on flexural test of carbon fiber reinforced plastic laminates
[NAL-TM-601] N90-29436
BENDING VIBRATION
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
BERYLLIUM OXIDES
Reliability study of TWT output RF window
[AD-A223688] N90-29574
Innovative techniques for the production of low cost 2D laser diode arrays
[AD-A223575] N90-29632
BIAS
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29828
BIBLIOGRAPHIES
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989
[AD-A224256] N90-29299
BINARY ALLOYS
A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
BINARY DIGITS
Formal verification of mathematical software, volume 2
[AD-A223633] N90-29943
Unique binary search tree representations and equality-testing of sets and sequences
[AD-A223643] N90-30002
BINARY STARS
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143
BINDERS (MATERIALS)
The optimum polymer binder for pressable high performance explosives: A preliminary evaluation
[ETN-90-97612] N90-29524
BIODYNAMICS
A human factors engineering approach to the development and dynamic evaluation of a prototype aircrew seat for military aircraft
[AD-A218283] N90-29779
BIOELECTRICITY
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
BIOMAGNETISM
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775
BIONICS
Microscopic models for electromagnetic wave propagation in highly dispersive media
[AD-A224382] N90-29540
Directing an animated scene with autonomous actors
[REPT-89-041] N90-29972
BIOSYNTHESIS
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765
BISMALEIMIDE
Thermal analysis of bismaleimide matrix resins
[DE90-016283] N90-29523
BIVARIATE ANALYSIS
Unification of statistical methods for continuous and discrete data
[AD-A224307] N90-30017
BLACK HOLES (ASTRONOMY)
Information loss down a black hole
[DE90-627482] N90-30154
BLADE TIPS
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
BLADE-VORTEX INTERACTION
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302
BLOCK COPOLYMERS
Modification of polystyrene/polybutadiene block copolymer films by chemical reaction with bromine and effect on gas permeability
[AD-A223612] N90-29513
BLUNT BODIES
A numerical calculation of hypersonic flow around blunt bodies using upwind difference scheme
[NAL-TR-1025] N90-29331
BODY TEMPERATURE
Pharmacological resetting of the circadian sleep-wake cycle effects of triazolam on reentrainment of circadian rhythms in a diurnal primate
[AD-A224227] N90-29764
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
BODY-WING CONFIGURATIONS
Studies of surface heat transfer in an arc-heated wind tunnel
[NAL-TR-1048] N90-29410
BOOLEAN ALGEBRA
Search strategies for computer-stored information: A microcomputer tutorial N90-30126
BORON
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
BORON FIBERS
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
BORON FLUORIDES
Pyrromethene-BF2 complexes as laser dyes
[AD-A223562] N90-29631
BOSONS
Effective actions for bosonic topological defects
[NASA-CR-187271] N90-30041
BOUNDARIES
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032
BOUNDARY CONDITIONS
Solution of nonlinear eigenvalue problems via parallel shooting
[LR-587] N90-30013
BOUNDARY INTEGRAL METHOD
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
BOUNDARY LAYER CONTROL
A numerical study of the response of the laminar unsteady separated flow about a circular cylinder to changes of boundary conditions
[DLR-FB-90-10] N90-29613
BOUNDARY LAYER EQUATIONS
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
BOUNDARY LAYER SEPARATION
Dynamic separation: Search for the cause of dynamic stall and search for its control
[AD-A223412] N90-29305
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
A numerical study of the response of the laminar unsteady separated flow about a circular cylinder to changes of boundary conditions
[DLR-FB-90-10] N90-29613
BOUNDARY LAYER TRANSITION
A boundary-layer transition model for the Navier-Stokes computation for a natural-laminar-flow airfoil
[NAL-TR-1038T] N90-29328
Transition of the boundary layer
[DERAT-RSF-50/5018-37] N90-29600
BOUNDARY LAYERS
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702

Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747

BOUNDARY VALUE PROBLEMS
The fundamentals of adaptive grid movement
N90-29610
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
An existence theorem for periodic solutions and applications to some third order nonlinear differential equations
[DE90-627152] N90-29992
Solution of nonlinear eigenvalue problems via parallel shooting
[LR-587] N90-30013

BRAGG ANGLE
An x ray source for lithography
[AD-D014596] N90-29630

BRAIN
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775

BREADBOARD MODELS
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Flight telerobotic servicer control from the Orbiter
N90-29882

BREATHING
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling
[LR-625] N90-29772

BRITTLE MATERIALS
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
High performance brittle matrices and brittle matrix composites, book 2
[AD-A223274] N90-29441

BRITTLENESS
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
Alloy design of ordered intermetallics
[DE90-016031] N90-29490

BROADBAND
Microwave active filters based on coupled negative resistance method
[AD-A223269] N90-29570
Audibility and annoyance of en route noise of unducted fan engines
[AD-A223687] N90-30035

BROMINE
Modification of polystyrene/polybutadiene block copolymer films by chemical reaction with bromine and effect on gas permeability
[AD-A223612] N90-29513

BROWNIAN MOVEMENTS
Hitting lines with two-dimensional Brownian motion
[AD-A223595] N90-30027

BRUSHES
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657

BRUSHES (ELECTRICAL CONTACTS)
Theoretical and experimental examinations of brushless monophase direct current motors
[ETN-90-97301] N90-29580

BUBBLES
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
Relic gravitational waves and extended inflation
[NASA-CR-186469] N90-29740

BUCKLING
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
Buckling of anisotropic cylindrical shells subjected to combined axial compression, normal pressure, bending and shear loading
[LR-611] N90-29678
Recent developments in shell stability analysis
[LR-633] N90-29685

BUOYANCY
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089

BURNING RATE
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526

BURSTS
SONA: A measurement system for the determination of the end-of-flight burst behaviour of projectiles equipped with proximity fuses
[FEL-89-A293] N90-29536

C

C-130 AIRCRAFT
A human factors engineering approach to the development and dynamic evaluation of a prototype aircrew seat for military aircraft
[AD-A218283] N90-29779

CABLES (ROPES)
Modeling towed cable system dynamics
[AD-A223610] N90-29644

CADMIUM SULFIDES
Optical nonlinearity due to structure defects and bistability in the band discontinuity area of CdS
[ETN-90-97303] N90-30112

CALCIUM OXIDES
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516

CALCULUS
Formal semantics of SQL queries
[REPT-89-069] N90-29973

CALIBRATING
Calibration of the PARC program for propulsion-type flows
[AD-A224253] N90-29395
Procedure for calibrating fly-by-wire control chains of the flying testbed ATTAS
[DLR-MITT-90-02] N90-29401
A 94 GHz transmissometer
[AD-A223309] N90-29618
Long-term flat-field behavior in LLNL streak cameras: Preliminary results
[DE90-015615] N90-29621
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
A review of manganin gauge technology for measurements in the gigapascal range
[MRL-TR-90-5] N90-30026
Database development for the DMSP experiments
[AD-A224346] N90-30129

CANADA
The nuclear battery
[DE90-630400] N90-29559

CANOPIES (VEGETATION)
Simulation and measurement of the heat exchange between the urban canopy and boundary layers
N90-29702

CAPACITORS
Application of a rechargeable, small caliber railgun power supply
[AD-A224207] N90-29418

CARBON DIOXIDE
Statistically designed study of the variables and parameters of carbon dioxide equations of state
[DE90-016196] N90-29467
Effects of increased CO2 on forest response
[DE90-015406] N90-29708

CARBON DIOXIDE CONCENTRATION
Effects of increased CO2 on forest response
[DE90-015406] N90-29708
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710
The effects of a doubling of atmospheric CO2 on the stormtracks in the climate of a general circulation model
[KNMI-WR-90-01] N90-29713

CARBON FIBER REINFORCED PLASTICS
Surface effect for test piece on flexural test of carbon fiber reinforced plastic laminates
[NAL-TM-601] N90-29436
Non-destructive method for environmental breakdown of graphite fiber reinforced polymer composites
[AD-A223729] N90-29515

CARBON FIBERS
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503
Non-destructive method for environmental breakdown of graphite fiber reinforced polymer composites
[AD-A223729] N90-29515

CARBON MONOXIDE
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151

CARBONYL COMPOUNDS
Chemical stabilization of laser dyes
[AD-A224219] N90-29627

CARDIOVASCULAR SYSTEM
Optimism and cardiovascular reactivity to psychological and cold pressor stress
[AD-A223818] N90-29771
Physiological metrics of mental workload: A review of recent progress
[NASA-CR-187290] N90-29777

CARRIER INJECTION
Extended characterization of the damage by hot charge carriers in gate oxide by short channel MOS field effect transistors
[ETN-90-97313] N90-30114

CARTILAGE
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765

CATALOGS (PUBLICATIONS)
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations
[NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition
[NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations
[NASA-TM-101880] N90-30123
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations
[NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations
[NASA-TM-89695] N90-30148

CAVITIES
Cavity aeroacoustics
[AD-A223853] N90-29307
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679

CELLS (BIOLOGY)
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765

CENTRAL PROCESSING UNITS
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357

CERAMICS
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
Effect of environment upon mechanical behavior of structural ceramics for application in the DOE ceramic technology for advanced heat engines project
[DE90-014770] N90-29500
Non-destructive evaluation of infiltration-toughened ceramics
[DE90-629716] N90-29501
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Wear of advanced ceramics: An overview
[DE90-012166] N90-29519
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520
Reliability study of TWT output RF window
[AD-A223688] N90-29574

CEREBRAL CORTEX
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775
CERENKOV COUNTERS
Search for neutrino events in the Kamiokande-2 detector in correlation with the solar-flare activity in March 1989
[DE90-508085] N90-30160
CERTIFICATION
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350
CHANNEL FLOW
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Direct numerical simulation of turbulent couette flow
[AD-A224287] N90-29589
Effects of 1 Hz imposed bulk flow unsteadiness on laminar/turbulent transition in a straight channel
[AD-A223396] N90-29594
Counter-current flow limitation in thin rectangular channels
[DE90-015124] N90-29599
CHANNEL NOISE
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A224392] N90-29725
CHAOS
Propagation of chaos and the McKean-Vlasov equation in duals of nuclear spaces
[AD-A224431] N90-30039
CHARACTERIZATION
Omega navigation signal characteristics N90-29389
Nondestructive material characterization
[DE90-015176] N90-29652
CHARGE CARRIERS
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
CHARGE COUPLED DEVICES
Long-term flat-field behavior in LLNL streak cameras: Preliminary results
[DE90-015615] N90-29621
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
CHARPY IMPACT TEST
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F
[PB90-207796] N90-29471
CHECKOUT
Strategies for tutoring multiple bugs
[AD-A223921] N90-29927
CHEMICAL ANALYSIS
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459
Progress toward synthesis of polymeric polyradicals
[AD-A223414] N90-29510
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Planar waveguide spectrometer
[DE90-016308] N90-30057
CHEMICAL BONDS
Thermochemical data for silicon-containing species from ab initio electronic structure calculations
[DE90-011024] N90-29463
Transition metal activation and functionalization of carbon-hydrogen bonds
[DE90-015826] N90-29489
CHEMICAL PROPERTIES
Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes
[DE90-016626] N90-29699
CHEMICAL REACTIONS
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098
CHEMILUMINESCENCE
Spectroscopy of propellant-related flames
[AD-A224068] N90-29525
CHEMISORPTION
On hydrogen chemisorption on metals: The electron correlation effects
[DE90-627318] N90-29473
Scanning tunneling microscopy studies of chemisorbed layers on metal surfaces
[DE90-015623] N90-29486
Oxidation of NiAl(110)
[DE90-015645] N90-29487
CHIPS (ELECTRONICS)
A single wafer bit-sliced convolver: An optimum statistical solution for the implementation of redundancy
[REPT-89-019] N90-29584
A VHDL interface for Altera design files
[AD-A224476] N90-29920
A comparison of hardware implementations for low-level vision algorithms
[AD-A223699] N90-29945
CHLOROCARBONS
Success of EPA's stratospheric ozone engineering research
[PB90-245265] N90-29706
CHROMIUM
Effects of low Chromium(3) concentration in electrodeposition of low contraction chromium
[AD-A223338] N90-29477
CHROMIUM ALLOYS
Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484
Isotopic tailoring and other techniques used to study helium effects in austenitic alloys
[DE90-016344] N90-29495
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
CIRCADIAN RHYTHMS
Pharmacological resetting of the circadian sleep-wake cycle effects of triazolam on reentrainment of circadian rhythms in a diurnal primate
[AD-A224227] N90-29764
Exogenous and endogenous control of activity behavior and the fitness of fish
[DLR-FB-90-14] N90-29766
CIRCUIT BOARDS
Using multiple sensors for printed circuit board insertion N90-29867
CIRCUIT DIAGRAMS
VLSI design for reliability
[AD-A224264] N90-29562
Macro cell placement with neural net algorithms
[REPT-90-020] N90-29585
CIRCUIT RELIABILITY
Reliability analysis/assesament of advanced technologies
[AD-A223647] N90-29573
CIRCULAR CYLINDERS
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
CIRCULAR WAVEGUIDES
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29568
CIRCULATION DISTRIBUTION
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
CIVIL AVIATION
GPS integrity requirements for use by civil aviation N90-29339
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364
CLASSIFICATIONS
Human error classification and data collection
[DE90-631408] N90-29915
CLEAN ROOMS
An advanced telerobotic system for shuttle payload changeout room processing applications N90-29795
Vacuum mechatronics N90-29854
CLEAVAGE
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F
[PB90-207796] N90-29471
CLIMATE
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691
CLIMATE CHANGE
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-208588] N90-29701
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704
Effects of increased CO2 on forest response
[DE90-015406] N90-29708
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710
The effects of a doubling of atmospheric CO2 on the stormtracks in the climate of a general circulation model
[KNMI-WR-90-01] N90-29713
CLIMATOLOGY
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-208588] N90-29701
CLOSED ECOLOGICAL SYSTEMS
A lunar space station
[NASA-CR-186223] N90-30158
CLOSURE LAW
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
CLOUD COVER
A documentation of icing-relevant cloud physical parameters on vertical soundings of stratiform clouds
[DLR-MITT-90-07] N90-29753
CLOUD GLACIATION
A documentation of icing-relevant cloud physical parameters on vertical soundings of stratiform clouds
[DLR-MITT-90-07] N90-29753
CLOUD PHYSICS
The signals of an ice warning device in dependence on total water content and normalized icing degree
[ESA-TT-1207] N90-29692
CLOUDS (METEOROLOGY)
The signals of an ice warning device in dependence on total water content and normalized icing degree
[ESA-TT-1207] N90-29692
Observations of tornadoes and wall clouds with a portable FM-CW Doppler radar: 1989--1990 results
[DE90-013152] N90-29752
A documentation of icing-relevant cloud physical parameters on vertical soundings of stratiform clouds
[DLR-MITT-90-07] N90-29753
CLUMPS
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151
CLUTTER
Radar clutter via ray methods
[AD-A223796] N90-29553
A 94 GHz transmissometer
[AD-A223309] N90-29618
Angle sample variance of azimuthally spread scattering processes, using a two-element array
[AD-A223572] N90-30034
CMOS
VLSI design for reliability
[AD-A224264] N90-29562
Parametric testing for the RSRE CMOS, silicon on sapphire process
[RSRE-MEMO-4369] N90-30115
COAL
Distributed communications and control network for robotic mining N90-29901
COAL GASIFICATION
Production of jet fuels from coal-derived liquids. Volume 13: Evaluation of storage and thermal stability of jet fuels derived from coal liquids
[AD-A224576] N90-29527
COATINGS
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
COCKPITS
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
CODING
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124
COGNITION
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
Ability and metacognitive determinants of skill acquisition and transfer
[AD-A224569] N90-29776
COGNITIVE PSYCHOLOGY
A design strategy for autonomous systems N90-29818

A layered abduction model of perception: Integrating bottom-up and top-down processing in a multi-sense agent N90-29851
COHERENT LIGHT
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
COHERENT RADAR
High range resolution radar cross-section profiles: A preliminary analysis
[AD-A223448] N90-29550
COHERENT SCATTERING
Feasibility of the temperature measurements in hypersonic flow by multibeam coherent Raman anti-Stokes scattering
[ONERA-RF-56/7131-PY] N90-29312
CARS spectroscopy and applications N90-29321
Angle sample variance of azimuthally spread scattering processes, using a two-element array
[AD-A223572] N90-30034
COLD PLASMAS
Transport of nonneutral plasmas
[AD-A223457] N90-30077
COLD PRESSING
Realization of equipment for manufacturing titanium alloy electrodes for first step melting
[ONERA-RT-15/3578-M] N90-29498
COLD TOLERANCE
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
Optimism and cardiovascular reactivity to psychological and cold pressor stress
[AD-A223818] N90-29771
Coping strategies and mood during cold weather training
[AD-A223915] N90-29773
COLD WEATHER
Coping strategies and mood during cold weather training
[AD-A223915] N90-29773
COLLAPSE
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
COLLISION AVOIDANCE
UK airmisses involving commercial air transport: May - August 1989
[ISSN-0951-6301] N90-29335
A collision avoidance system for a spaceplane manipulator arm N90-29903
An Ada-based marine radar simulator for collision avoidance training
[ETN-90-97611] N90-29970
COLLOCATION
A parallel least squares collocation conjugate gradient approach for the advection diffusion equation
[DE90-015965] N90-29961
COLOR
A land navigation demonstration vehicle with a color map display for tactical use N90-29375
Satellite navigation systems for land vehicles N90-29376
Digital color representation
[DE90-014580] N90-29924
COLOR CODING
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133
COLOR-MAGNITUDE DIAGRAM
An observational study of disk-population globular clusters N90-30145
COMBAT
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
COMBUSTIBLE FLOW
AFOSR/ONR Contractors' Meeting on Combustion Rocket Propulsion Diagnostics of Reacting Flow
[AD-A224411] N90-29432
COMBUSTION
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397
COMBUSTION CHAMBERS
Solid fuel combustion chamber
[LR-634] N90-29433
COMBUSTION EFFICIENCY
Solid fuel combustion chamber
[LR-634] N90-29433
COMBUSTION PHYSICS
Combustion characteristics of oxygen/hydrogen high pressure preburners for staged combustion cycle rocket engine
[NAL-TR-1044] N90-29434
COMET NUCLEI
Dust emission by Comet P/Halley 1982i N90-30159
COMETS
The Tempel 2 dust trail
[AD-A224395] N90-30153
IUE-ULDA access guide no. 2. International Ultraviolet Explorer-Uniform Low Dispersion Archive: Comets
[ESA-SP-1134] N90-30157
Dust emission by Comet P/Halley 1982i N90-30159
COMMERCE
Software development: A product life-cycle perspective
[AD-A223783] N90-29952
COMMERCIAL AIRCRAFT
Airline productivity relating on the fuel cost. (2): Fuel consumption values and fuel efficiency
[NAL-TM-604-2] N90-29333
UK airmisses involving commercial air transport: May - August 1989
[ISSN-0951-6301] N90-29335
COMMONALITY
Ring laser gyro marine inertial navigation systems N90-29355
COMMUNICATION NETWORKS
PLRS: A new spread spectrum position location reporting system N90-29358
Enhancing PLRS with user-to-user data capability N90-29359
Using minimal spanning trees to compare the reliability of network topologies
[NASA-TM-4208] N90-30014
COMMUNICATION THEORY
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124
COMMUTATORS
Development of an all solid state 6 kHz pulse generator for driving free electron laser amplifiers
[AD-A224105] N90-29561
COMPARISON
Norms and perception of events
[AD-A224236] N90-29774
COMPATIBILITY
Compatibility of elastomeric seal compounds with MIL-H-6083 and MIL-H-46170 hydraulic fluid
[AD-A224248] N90-29504
COMPENSATORS
Sample rate effects on disturbance rejection for digital control systems N90-29400
COMPLEX COMPOUNDS
Transition metal activation and functionalization of carbon-hydrogen bonds
[DE90-015826] N90-29489
COMPLEX SYSTEMS
System architectures for telerobotic research N90-29872
COMPLEX VARIABLES
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679
COMPONENT RELIABILITY
Recommended practices for measurement of gas path pressures and temperatures for performance assessment of aircraft turbine engines and components
[AGARD-AR-245] N90-29393
COMPOSITE MATERIALS
The overall response of composite materials undergoing large elastic deformations
[AD-A224509] N90-29439
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
High performance brittle matrices and brittle matrix composites, book 2
[AD-A223274] N90-29441
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite
[AD-A223696] N90-29445
Powder processing of aluminides
[DE90-015314] N90-29447
The friction and wear of lubricated Si3N4/SiC(w) composites
[DE90-015790] N90-29448
Wear of advanced ceramics: An overview
[DE90-012166] N90-29519
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
COMPOSITE STRUCTURES
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates
[AD-A223451] N90-29442
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
Practical superconductor development for electrical power applications
[DE90-014896] N90-30109
COMPRESSIBILITY
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
COMPRESSIBLE FLOW
Numerical simulation supersonic free shear layers
[AD-A223771] N90-29306
Thermal transfers in unsteady compressible inviscid flow
[ETN-90-97557] N90-29311
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
Transition of the boundary layer
[DERAT-RSF-50/5018-37] N90-29600
COMPRESSOR BLADES
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Experimental study on the dynamic behavior of a revolving blade grill
[REPT-NT-89-CC-18] N90-29604
COMPUTATION
Thermal transfers in unsteady compressible inviscid flow
[ETN-90-97557] N90-29311
Estimation of liquid heat capacities. 1: Review and evaluation of Missenard method
[AD-A224161] N90-29454
Accurate calculations of neutron kerma and damage from ENDF/B-VI evaluations for silicon, chromium, iron and nickel, and comparison with ENDF/B-V results
[DE90-016020] N90-29674
Recent developments in shell stability analysis
[LR-633] N90-29685
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953
A canonical integration technique of arbitrary order
[DE90-628377] N90-30025
On a calculation of the ground-state energy in quantum mechanics
[DE90-627182] N90-30119
COMPUTATIONAL FLUID DYNAMICS
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE)
[NAL-TR-1028] N90-29330
Some topics in computational transonic aerodynamics: Revision
[NAL-TR-1018T] N90-29332
Secondary flow in presence of wall jets: Incorporation of compression effects in a quasi-elliptic Navier-Stokes calculation code
[ETN-90-97559] N90-29602
Optimization of tetrahedrical meshes for finite element calculation methods in fluids mechanics
[ETN-90-97560] N90-29603
Numerical Grid Generation
[VKI-LS-1990-06] N90-29606
Grid generation N90-29607
Unstructured mesh methods for CFD N90-29611
COMPUTATIONAL GEOMETRY
Numerical Grid Generation
[VKI-LS-1990-06] N90-29606
Unstructured mesh methods for CFD N90-29611
COMPUTATIONAL GRIDS
Numerical Grid Generation
[VKI-LS-1990-06] N90-29606
Grid generation N90-29607
The fundamentals of adaptive grid movement N90-29610
Unstructured mesh methods for CFD N90-29611
Elliptic grid generation N90-29612
Unstructured mesh relaxation
[DE90-015614] N90-29989
COMPUTER AIDED DESIGN
WingDesign: Program for the structural design of a wing cross-section
[LR-627] N90-29390
Assessment and improvement of aeroengine disc structural integrity N90-29392
CAD models for inductive strips in homogeneous finline: The methodology
[AD-A224446] N90-29564

Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
MacRootLocus: A CAD design tool for feedback control systems
[AD-A223772] N90-29951
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954

COMPUTER ANIMATION
Directing an animated scene with autonomous actors
[REPT-89-041] N90-29972

COMPUTER ASSISTED INSTRUCTION
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis
[DE90-008944] N90-29778
Strategies for tutoring multiple bugs
[AD-A223921] N90-29927

COMPUTER GRAPHICS
The 2-D and 3-D characterizations of GPS navigation service N90-29348
Satellite navigation systems for land vehicles N90-29376
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
Telepresence system development for application to the control of remote robotic systems N90-29799
Graphic overlays in high-precision teleoperation: Current and future work at JPL N90-29827
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29828
Use of graphics in decision aids for telerobotic control: (Parts 5-8 of an 8-part MIT progress report) N90-29829
Realtime multi-plot graphics system
[NASA-CR-4304] N90-29919
Digital color representation
[DE90-014580] N90-29924
Machine recognition as representation and search
[AD-A223700] N90-29946
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954
Ray traced scalar fields with shaded polygonal output
[DE90-011023] N90-29955
A manual for microcomputer image analysis
[DE90-015629] N90-29958
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016127] N90-29962
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016126] N90-29964
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133

COMPUTER INFORMATION SECURITY
A survey of object-oriented database technology
[AD-A224490] N90-30130

COMPUTER NETWORKS
Distributed communications and control network for robotic mining N90-29901
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016127] N90-29962
Supporting large scale applications on networks of workstations
[NASA-CR-186346] N90-29975
Low cost management of replicated data in fault-tolerant distributed systems
[NASA-CR-186370] N90-29976
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977
Fault tolerant design for multistage routing networks
[AD-A224267] N90-29978
Accessing network databases via SQL transactions in a multi-model database system
[AD-A223946] N90-30128

COMPUTER PROGRAM INTEGRITY
Software design for high integrity systems
[ETN-90-97517] N90-29966
Analysis and synthesis of robust data structures
[AD-A224568] N90-30131

COMPUTER PROGRAMMING
THREAD: A programming environment for interactive planning-level robotics applications N90-29810
A VHDL interface for Altera design files
[AD-A224476] N90-29920
Programming your way out of the past: ISIS and the META Project
[NASA-CR-186275] N90-29922
Development of a software package for automatic data acquisition, analysis, and controls in an axial flow compressor test rig
[PD-PR-8910] N90-29926
Strategies for tutoring multiple bugs
[AD-A223921] N90-29927
Tutorial on using LISP object-oriented programming for blackboards: Solving the radar tracking problem
[AD-A224272] N90-29930
Effects of parameter uncertainties on software development effort estimates
[AD-A223304] N90-29938
Durra: A task-level description language user's manual
[AD-A223761] N90-29950
Software development: A product life-cycle perspective
[AD-A223783] N90-29952
GSHELL: Multichannel analyzer/multichannel scaler emulation software for IBM-PC-compatible computers
[DE90-015396] N90-29956
Automated CADAM data transfer: User's manual
[DE90-014871] N90-29963
Software design for high integrity systems
[ETN-90-97517] N90-29966
Supporting large scale applications on networks of workstations
[NASA-CR-186346] N90-29975
Assessment System for Aircraft Noise (ASAN): Development of alpha-test prototype system software
[AD-A223770] N90-30036

COMPUTER PROGRAMS
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
A package for 3-D unstructured grid generation, finite-element flow solution and flow field visualization
[NASA-CR-182090] N90-29309
Integration of GPS and strapdown inertial subsystems into a single unit N90-29340
Applications of differential GPS N90-29349
Inertial navigation system simulator program: Top-level design
[AD-A223762] N90-29379
WingDesign: Program for the structural design of a wing cross-section
[LR-627] N90-29390
Generalized Advanced Propeller Analysis System (GAPAS). Volume 2: Computer program user manual
[NASA-CR-185277] N90-29394
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
Satellite Constellation Orbit Evaluation (SCORE) program
[AD-A223531] N90-29417
AutoPAVER: A software package for automated pavement evaluation
[AD-A224176] N90-29531
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing
[AD-A224510] N90-29543
The f2 dominance of the energy-momentum tensor
[DE90-508027] N90-29544
High range resolution radar cross-section profiles: A preliminary analysis
[AD-A223448] N90-29550
Specification for a standard electromagnetic propagation model
[AD-A223556] N90-29551
CAD models for inductive strips in homogeneous finline: The methodology
[AD-A224446] N90-29564
Utilization of a measurement process by the examination of universal motors
[ETN-90-97307] N90-29581
Buckling of anisotropic cylindrical shells subjected to combined axial compression, normal pressure, bending and shear loading
[LR-611] N90-29678
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
Studies of ionospheric dynamics utilizing data from DMSP
[AD-A223370] N90-29733
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling
[LR-625] N90-29772
Autonomous sensor-based dual-arm satellite grappling N90-29809
THREAD: A programming environment for interactive planning-level robotics applications N90-29810
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29891
A collision avoidance system for a spaceplane manipulator arm N90-29903
Realtime multi-plot graphics system
[NASA-CR-4304] N90-29919
Issues in expanding the software base management system supporting the Computer Aided Prototyping System (CAPS)
[AD-A224344] N90-29933
The effect of software reusability on information theory based software metrics
[AD-A224472] N90-29936
Formal verification of mathematical software, volume 2
[AD-A223633] N90-29943
MacRootLocus: A CAD design tool for feedback control systems
[AD-A223772] N90-29951
Software development: A product life-cycle perspective
[AD-A223783] N90-29952
Developing tools for performance visualization of parallel algorithms
[DE90-015801] N90-29960
Directing an animated scene with autonomous actors
[REPT-89-041] N90-29972
An analysis of the distinction between deep and shallow expert systems
[AD-A224443] N90-29987
Unstructured mesh relaxation
[DE90-015614] N90-29989
Investigation of the application in the simulation program 'PSpice' of the Jiles-Atherton model for nonlinear magnetic materials in order to predict the degaussing of magnets
[LINO-1990-1] N90-30029
Establishment of a capability to measure optical transition radiation
[AD-A224094] N90-30047
Beam and plasma physics research
[AD-A224452] N90-30067
Compact toroid research
[DE90-016123] N90-30087
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093
Analysis and synthesis of robust data structures
[AD-A224568] N90-30131

COMPUTER STORAGE DEVICES
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775
A high-speed KDL-RAM file system for parallel computers
[AD-A223299] N90-29979

COMPUTER SYSTEMS DESIGN
Realtime multi-plot graphics system
[NASA-CR-4304] N90-29919
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977
Asynchronous design for parallel processing architectures
[AD-A223754] N90-29981
Accessing network databases via SQL transactions in a multi-model database system
[AD-A223946] N90-30128

COMPUTER SYSTEMS PERFORMANCE
Assembler for a parallel computer
[NAL-TM-586] N90-29974
Supporting large scale applications on networks of workstations
[NASA-CR-186346] N90-29975
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977
An analysis of the distinction between deep and shallow expert systems
[AD-A224443] N90-29987
Analysis and synthesis of robust data structures
[AD-A224568] N90-30131

COMPUTER SYSTEMS PROGRAMS
System software for Soviet computers N90-29921

Communications Interface Driver (CID) software principles of operation
[DOT/FAA/CT-TN89/46] N90-29937

COMPUTER SYSTEMS SIMULATION
Assembler for a parallel computer
[NAL-TM-586] N90-29974

COMPUTER TECHNIQUES
Issues in expanding the software base management system supporting the Computer Aided Prototyping System (CAPS)
[AD-A224344] N90-29933
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996

COMPUTER VISION
Neural nets and eddy-current testing
[DE90-016044] N90-29656
The 3D model control of image processing N90-29800
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
Trinocular stereovision using figural continuity, dealing with curved objects N90-29802
A fast 3-D object recognition algorithm for the vision system of a special-purpose dexterous manipulator N90-29803
Use of 3D vision for fine robot motion N90-29804
Telerobotic workstation design aid N90-29805
Space robotic system for proximity operations N90-29806
Modeling and sensory feedback control for space manipulators N90-29807
Control strategies for a telerobot N90-29808
Autonomous sensor-based dual-arm satellite grappling N90-29809
The 3-D vision system integrated dexterous hand N90-29850
Assembly of objects with not fully predefined shapes N90-29859
A comparison of hardware implementations for low-level vision algorithms
[AD-A223699] N90-29945
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948

COMPUTERIZED SIMULATION
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1046] N90-29326
Enhancing PLRS with user-to-user data capability N90-29359
Inertial navigation system simulator program: Top-level design
[AD-A223762] N90-29379
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424
User's manual for the Trajectory Simulation and Analysis Program (TSAP)
[DE90-014850] N90-29426
Bistatic radar cross section of a perfectly conducting rhombus-shaped flat plate
[AD-A223418] N90-29546
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed
[AD-A223446] N90-29549
Long pulse diode experiments
[DE90-016218] N90-29578
Macro cell placement with neural net algorithms
[REPT-90-020] N90-29585
An additive turbulent decomposition of the Navier-Stokes equations implemented on highly parallel computer systems
[AD-A223678] N90-29595
The ACR-program for automatic finite element model generation for part through cracks
[DE90-631545] N90-29662
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
Atmospheric structure and variability
[AD-A223439] N90-29734
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746
Autonomous sensor-based dual-arm satellite grappling N90-29809
Response to reflected-force feedback to fingers in teleoperations N90-29837
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
Application of recursive manipulator dynamics to hybrid software/hardware simulation N90-29876
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877
Inverse dynamics of a 3 degree of freedom spatial flexible manipulator N90-29878
Computer simulation and design of a three degree-of-freedom shoulder module N90-29902
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954
Ray traced scalar fields with shaded polygonal output
[DE90-011023] N90-29955
A reduced-order extended Kalman filter for moving images
[AD-A223742] N90-30028
Three dimensional studies of helical equilibria and magnetic surface breaking due to the finite beta effect
[DE90-508078] N90-30071
Monte Carlo simulation of complex spectra for opacity calculations
[DE90-015198] N90-30147
Dust emission by Comet P/Halley 1982i N90-30159

COMPUTERS
The development and evaluation of numerical algorithms for MIMD computers
[NASA-TM-101167] N90-29939

CONCENTRATORS
Some studies related to a new Hexagonal Compound Parabolic Concentrator (HCPC) as a secondary in tandem with a solar tower
[DLR-FB-90-12] N90-29700

CONCRETES
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934

CONCURRENT PROCESSING
Inertial navigation system simulator program: Top-level design
[AD-A223762] N90-29379
Programming your way out of the past: ISIS and the META Project
[NASA-CR-186275] N90-29922
Language and system support for concurrent programming
[AD-A223760] N90-29949
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977
Fact system: A standardizing modelization processing for concurrent systems
[ETN-90-97286] N90-29982

CONDUCTIVE HEAT TRANSFER
Approximate equations for heat conduction in multi-layered cylindrical shells
[NAL-TR-1049] N90-29614

CONFERENCES
The Second ARO Workshop on Rotorcraft Interactional Aerodynamics
[AD-A223310] N90-29304
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
AFOSR/ONR Contractors' Meeting on Combustion Rocket Propulsion Diagnostics of Reacting Flow
[AD-A224411] N90-29432
Proceedings of the 45th Ohio State University Symposium on Molecular Spectroscopy
[AD-A224349] N90-29457
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic
[AD-A223611] N90-29552
Proceedings of the 14th Annual Electronics Manufacturing Seminar
[AD-A224276] N90-29563
Report on the International Workshop on Progress Towards Molecular Scale Electronics
[AD-A223758] N90-29575
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
Proceedings of the NASA Conference on Space Telerobotics, volume 3
[NASA-CR-186858] N90-29780
Proceedings of the NASA Conference on Space Telerobotics, volume 4
[NASA-CR-186859] N90-29830
Proceedings of the NASA Conference on Space Telerobotics, volume 5
[NASA-CR-186860] N90-29874
Working implementation agreements for open systems interconnection protocols
[PB90-197948] N90-30127

CONFIGURATION MANAGEMENT
Performance monitoring, fault detection, fault localization design guidance
[AD-A223619] N90-29655

CONFORMAL MAPPING
A canonical integration technique of arbitrary order
[DE90-628377] N90-30025

CONGRESSIONAL REPORTS
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704
Environmental quality, 1970 - 1990
[PB90-214610] N90-29705
NASA authorization, 1991, volume 2
[GPO-32-196] N90-30138

CONICAL FLOW
The experimental investigation of flow in the core of a vortex structure
[BR114893] N90-29597

CONJUGATE GRADIENT METHOD
Efficient conjugate gradient algorithms for computation of the manipulator forward dynamics N90-29864
A parallel least squares collocation conjugate gradient approach for the advection diffusion equation
[DE90-015965] N90-29961
A new look at conjugate direction methods of optimization
[MATHS-REPT-A-125] N90-30010

CONJUGATES
A new look at conjugate direction methods of optimization
[MATHS-REPT-A-125] N90-30010

CONNECTORS
Quick-connect coupler for remote manipulation
[DE90-015352] N90-29648

CONSOLIDATION
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505

CONSTRAINTS
A comparison of alternative families of transformations for variables constrained to lie on the interval (0,1)
[MATHS-REPT-A-126] N90-30011

CONTACT LOADS
Surface effect for test piece on flexural test of carbon fiber reinforced plastic laminates
[NAL-TM-601] N90-29436

CONTACT RESISTANCE
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657

CONTAMINATION
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712

CONTINENTAL SHELVES
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739

CONTINUITY (MATHEMATICS)
Unification of statistical methods for continuous and discrete data
[AD-A224307] N90-30017

CONTINUUMS
Formation of hydrogen line and continuum emission in young stellar objects N90-30150

CONTOURS
Non-contact contour gage
[DE90-014672] N90-29642

CONTRACTION
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460

CONTROL BOARDS
Flight telerobotic servicer control from the Orbiter N90-29882

CONTROL EQUIPMENT
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
Distributed communications and control network for robotic mining N90-29901
CONTROL MOMENT GYROSCOPES
A new momentum management controller for the space station
[NASA-CR-187265] N90-29425
CONTROL SIMULATION
Test and validation for robot arm control dynamics simulation N90-29826
CONTROL STABILITY
Stability analysis of multiple-robot control systems N90-29811
On the stability of robotic systems with random communication rates N90-29865
CONTROL SYSTEMS DESIGN
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
Integrated navigation/flight control for future high performance aircraft N90-29362
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
Sample rate effects on disturbance rejection for digital control systems N90-29400
A three axis attitude control of a satellite
[NASDA-TR-22] N90-29421
High frequency bundle protection
[DIGEL-1990-1] N90-29582
Robust design of LQG controllers N90-29639
Proceedings of the NASA Conference on Space Telerobotics, volume 3
[NASA-CR-186858] N90-29780
Capture of free-flying payloads with flexible space manipulators N90-29784
Technology and task parameters relating to the effectiveness of the bracing strategy N90-29785
Manipulators with flexible links: A simple model and experiments N90-29786
Experiments in identification and control of flexible-link manipulators N90-29787
Impedance hand controllers for increasing efficiency in teleoperations N90-29793
Stability analysis of multiple-robot control systems N90-29811
Experiments in cooperative manipulation: A system perspective N90-29812
On the manipulability of dual cooperative robots N90-29813
Controlling multiple manipulators using RIPS N90-29814
Time optimal movement of cooperating robots N90-29815
Design of a structural and functional hierarchy for planning and control of telerobotic systems N90-29820
The flight telerobotic servicer project: A technical overview N90-29821
The flight telerobotic servicer Tinman concept: System design drivers and task analysis N90-29822
The flight telerobotic servicer: From functional architecture to computer architecture N90-29823
The Goddard Space Flight Center (GSFC) robotics technology testbed N90-29825
Direct adaptive control of a PUMA 560 industrial robot N90-29832
Model based manipulator control N90-29833
Discrete-time adaptive control of robot manipulators N90-29834
A discrete decentralized variable structure robotic controller N90-29835
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
Response to reflected-force feedback to fingers in teleoperations N90-29837
The JAU-JPL anthropomorphic telerobot N90-29838
A procedure concept for local reflex control of grasping N90-29839
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
Sensor-based fine telemanipulation for space robotics N90-29841
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Information management in an integrated space telerobot N90-29846
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
RCTS: A flexible environment for sensor integration and control of robot systems; the distributed processing approach N90-29852
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Determining robot actions for tasks requiring sensor interaction N90-29868
The laboratory telerobotic manipulator program N90-29869
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870
System architectures for telerobotic research N90-29872
The telerobot workstation testbed for the shuttle aft flight deck: A project plan for integrating human factors into system design N90-29887
Multi-level manual and autonomous control superposition for intelligent telerobot N90-29888
An alternative control structure for telerobotics N90-29889
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29891
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
On discrete control of nonlinear systems with applications to robotics N90-29893
Flight experiments in telerobotics-Orbiter middeck concept N90-29895
Computed torque control of a free-flying cooperat ing-arm robot N90-29898
Coordination in a hierarchical multi-actuator controller N90-29900
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
MacRootLocus: A CAD design tool for feedback control systems
[AD-A223772] N90-29951
Directing an animated scene with autonomous actors
[REPT-89-041] N90-29972
CONTROL THEORY
Control and estimation for aerospace applications with system time delays N90-29367
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Capture of free-flying payloads with flexible space manipulators N90-29784
Control strategies for a telerobot N90-29808
Stability analysis of multiple-robot control systems N90-29811
Performance constraints and compensation for teleoperation with delay N90-29881
Software design for high integrity systems
[ETN-90-97517] N90-29966
Optimal control law phenomena in certain adaptive second-order observation systems
[AD-A224274] N90-29986
CONTROL UNITS (COMPUTERS)
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
CONTROLLABILITY
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
CONTROLLERS
Sample rate effects on disturbance rejection for digital control systems N90-29400
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402
A new momentum management controller for the space station
[NASA-CR-187265] N90-29425
Concept for a reference model Architecture for Real-Time Intelligent Control Systems (ARTICS)
[PB90-220286] N90-29638
Robust design of LQG controllers N90-29639
Adaptive control of an arc welding process
[AD-A223626] N90-29645
Experiments in identification and control of flexible-link manipulators N90-29787
Autonomous dexterous end-effectors for space robotics N90-29788
Design and control of a multi-fingered robot hand provided with tactile feedback N90-29789
Impedance hand controllers for increasing efficiency in teleoperations N90-29793
Control strategies for a telerobot N90-29808
Experiments in cooperative manipulation: A system perspective N90-29812
Direct adaptive control of a PUMA 560 industrial robot N90-29832
Discrete-time adaptive control of robot manipulators N90-29834
A discrete decentralized variable structure robotic controller N90-29835
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
The JAU-JPL anthropomorphic telerobot N90-29838
A procedure concept for local reflex control of grasping N90-29839
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Real-time cartesian force feedback control of a teleoperated robot N90-29857
An alternative control structure for telerobotics N90-29889
Flight experiments in telerobotics-Orbiter middeck concept N90-29895
Coordination in a hierarchical multi-actuator controller N90-29900
An efficient temporal logic for robotic task planning N90-29906
Approach to telerobot computing architecture
[NASA-CR-186993] N90-29984
CONVECTION
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
CONVECTIVE FLOW
Geophysical turbulence research at NCAR
[AD-A223361] N90-29732
CONVECTIVE HEAT TRANSFER
Thermographic phosphor technique N90-29324
CONVERGENCE
An algebraic hierarchical basis preconditioner
[DE90-015875] N90-30008
COOL STARS
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143
COOLING
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite
[AD-A223696] N90-29445
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
COOLING SYSTEMS
Analysis of scramjet engine characteristics
[NAL-TR-1041] N90-29398
Thermal analyses of power subsystem components
[NASA-CR-186314] N90-29637
COORDINATE TRANSFORMATIONS
Local interpolation functions for curve generation with the multi-surface transformation N90-29608
The control point form of algebraic grid generation N90-29609
COORDINATES
The control point form of algebraic grid generation N90-29609
Brorfelde Geomagnetic Observatory: Magnetic results, 1987
[ISBN-87-7478-297-5] N90-29756
COORDINATION
Coordination in a hierarchical multi-actuator controller N90-29900
COPOLYMERS
Toughening of SAN copolymers by an SAN emulsion grafted rubber
[AD-A224213] N90-29502
COPPER
Reliability study of TWT output RF window
[AD-A223688] N90-29574
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663

COPPER OXIDES
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098
CORONAS
A review of self generated B-field in ICF corona
[DE90-627479] N90-30063
CORRECTION
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996
CORRELATION
Reliability and performance of friction measuring tires and friction equipment correlation
[AD-A223694] N90-29408
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996
Sensitivity of the error in multivariate statistical interpolation to parameter values
[AD-A224076] N90-30015
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
New real space correlated-basis-functions approach for the electron correlations of the semiconductor inversion layer
[DE90-627315] N90-30090
CORRELATION COEFFICIENTS
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996
CORROSION
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
CORROSION RESISTANCE
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
COSMIC DUST
The Tempel 2 dust trail
[AD-A224395] N90-30153
COSMIC RAYS
Heavy Nucleus Collector (HNC) project for the NASA Long Duration Exposure Facility (LDEF)
[NASA-CR-182094] N90-30045
A search for low energy cosmic ray antiprotons N90-30161
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
An advanced single event upset tester
[AD-A223613] N90-30163
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166
COSMOLOGY
Relic gravitational waves and extended inflation
[NASA-CR-186469] N90-29740
A new vector-tensor theory and higher-dimensional cosmology
[DE90-507990] N90-30117
COST ANALYSIS
Airline productivity relating on the fuel cost. (2): Fuel consumption values and fuel efficiency
[NAL-TM-604-2] N90-29333
Effects of parameter uncertainties on software development effort estimates
[AD-A223304] N90-29938
COST EFFECTIVENESS
Ring laser gyro principles and techniques N90-29352
Ring laser gyro marine inertial navigation systems N90-29355
COST ESTIMATES
Effects of parameter uncertainties on software development effort estimates
[AD-A223304] N90-29938
COST REDUCTION
The cost of air service fragmentation
[TT-9010] N90-29334
COUETTE FLOW
Direct numerical simulation of turbulent couette flow
[AD-A224287] N90-29589
COUNTERFLOW
Counter-current flow limitation in thin rectangular channels
[DE90-015124] N90-29599
COUPLERS
Quick-connect coupler for remote manipulation
[DE90-015352] N90-29648
COUPLING CIRCUITS
Microwave active filters based on coupled negative resistance method
[AD-A223269] N90-29570
COUPLINGS
Quick-connect coupler for remote manipulation
[DE90-015352] N90-29648
COVALENT BONDS
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093
COVARIANCE
An error estimate for Tremolieres method for the discretization of parabolic variational inequalities
[DE90-627169] N90-30024
CRACK CLOSURE
Comparison of crack closure result obtained by 3D elastic-plastic FEM and modified Dugdale model
[FFA-TN-1990-18] N90-29675
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
CRACK INITIATION
An investigation of crack-tip stress field criteria for predicting cleavage-crack initiation
[DE90-015597] N90-29672
Fractographic analysis of fatigue crack growth under two-blocks loading on 2024-T351 sheet specimens
[LR-628] N90-29680
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
CRACK PROPAGATION
Assessment and improvement of aeroengine disc structural integrity N90-29392
Powder processing of aluminides
[DE90-015314] N90-29447
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Effect of environment upon mechanical behavior of structural ceramics for application in the DOE ceramic technology for advanced heat engines project
[DE90-014770] N90-29500
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507
An investigation of crack-tip stress field criteria for predicting cleavage-crack initiation
[DE90-015597] N90-29672
Fractographic observations on fatigue crack growth under miniTWIST flight-simulation loading (2024-T3 material)
[LR-631] N90-29684
CRACK TIPS
Studies on crack mechanics
[AD-A223634] N90-29670
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679
CRACKS
A welding metallurgy study of Hastelloy Alloys B-2 and W
[DE90-011910] N90-29481
The ACR-program for automatic finite element model generation for part through cracks
[DE90-631545] N90-29662
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683
CREEP PROPERTIES
The overall response of composite materials undergoing large elastic deformations
[AD-A224509] N90-29439
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480
Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design
[DE90-016039] N90-29491
CREEP STRENGTH
High performance brittle matrices and brittle matrix composites, book 2
[AD-A223274] N90-29441
CRITERIA
Search strategies for computer-stored information: A microcomputer tutorial N90-30126
CRITICAL LOADING
Buckling of anisotropic cylindrical shells subjected to combined axial compression, normal pressure, bending and shear loading
[LR-611] N90-29678
CROSS FLOW
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
CROSS POLARIZATION
Polarization correction of Luneburg lens with chiral medium
[PB90-189127] N90-30046
CRUDE OIL
Statistically designed study of the variables and parameters of carbon dioxide equations of state
[DE90-016196] N90-29467
CRYOGENICS
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695
CRYOSTATS
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088
CRYSTAL DEFECTS
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093
Optical nonlinearity due to structure defects and bistability in the band discontinuity area of CdS
[ETN-90-97303] N90-30112
CRYSTAL GROWTH
Kinetic pathway in Stranski-Krastanov growth of Ge on Si(001)
[AD-A224324] N90-29456
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
Research on mercury cadmium telluride
[AD-A224250] N90-29474
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
Mechanism of habit change for atmospheric ice crystal growth N90-29717
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093
High throughput MBE materials for MODFET's
[AD-A223452] N90-30097
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100
Manufacturing and characterization of liquid-phase epitaxy layers with atomic levels at the crystal surface and at the hetero limit surfaces in the system GaAs-AlGaAs
[ETN-90-97310] N90-30113
CRYSTAL LATTICES
Mechanism of habit change for atmospheric ice crystal growth N90-29717
CRYSTAL OPTICS
Image amplification in photoreactive crystals and utilization in optical reaction systems
[ETN-90-97285] N90-30059
CRYSTAL OSCILLATORS
Image amplification in photoreactive crystals and utilization in optical reaction systems
[ETN-90-97285] N90-30059
CRYSTAL STRUCTURE
Kinetic pathway in Stranski-Krastanov growth of Ge on Si(001)
[AD-A224324] N90-29456
Microscopic aspects of the initial stages of epitaxial growth. A scanning tunneling microscopy study
[AD-A224325] N90-30094
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102
Transmission electron microscopy study of ICB Al on Ge and Si(001) substrates
[DE90-015299] N90-30103
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108

A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
CRYSTAL SURFACES
Manufacturing and characterization of liquid-phase epitaxy layers with atomic levels at the crystal surface and at the hetero limit surfaces in the system GaAs-AlGaAs
[ETN-90-97310] N90-30113
CRYSTALLINITY
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
CRYSTALLOGRAPHY
Polycrystalline diamond Junction Field Effect Transistors (JFETS)
[AD-A223784] N90-29576
CRYSTALS
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
CULTURE TECHNIQUES
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765
CURRENT DENSITY
VLSI design for reliability
[AD-A224264] N90-29562
CURVATURE
Trinocular stereovision using figural continuity, dealing with curved objects N90-29602
CURVES (GEOMETRY)
Local interpolation functions for curve generation with the multi-surface transformation N90-29608
CYCLIC HYDROCARBONS
Novel macrocyclic carriers for proton-coupled liquid membrane transport
[DE90-015529] N90-29453
CYLINDRICAL BODIES
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
CYLINDRICAL SHELLS
Approximate equations for heat conduction in multi-layered cylindrical shells
[NAL-TR-1049] N90-29614
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658
Buckling of anisotropic cylindrical shells subjected to combined axial compression, normal pressure, bending and shear loading
[LR-611] N90-29678
CYLINDRICAL TANKS
Investigation of the dynamic buckling of liquid-filled tanks N90-29660

D

D REGION
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves
[AD-A223685] N90-29738
DAMAGE
Aircraft battle damage repair of transparencies
[AD-A224168] N90-29387
Non-destructive method for environmental breakdown of graphite fiber reinforced polymer composites
[AD-A223729] N90-29515
DAMAGE ASSESSMENT
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
DATA ACQUISITION
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform
[NASA-CR-186226] N90-29381
Human error classification and data collection
[DE90-631408] N90-29915
Development of a software package for automatic data acquisition, analysis, and controls in an axial flow compressor test rig
[PD-PR-8910] N90-29926
Diagnostic development and support of MHD test facilities
[DE90-015403] N90-30083
Small multipurpose stored data acquisition system
[DE90-010823] N90-30134
DATA BASE MANAGEMENT SYSTEMS
System software for Soviet computers N90-29921
Issues in expanding the software base management system supporting the Computer Aided Prototyping System (CAPS)
[AD-A224344] N90-29933
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016128] N90-29964
ESTEC software catalogue
[ESA-SP-1133] N90-29968
Formal semantics of SQL queries
[REPT-89-069] N90-29973
A high-speed KDL-RAM file system for parallel computers
[AD-A223299] N90-29979
Accessing network databases via SQL transactions in a multi-model database system
[AD-A223946] N90-30128
A survey of object-oriented database technology
[AD-A224490] N90-30130
Integration of information systems components
[DE90-011761] N90-30136
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137
DATA BASES
The 2-D and 3-D characterizations of GPS navigation service N90-29348
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations
[NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition
[NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
Results from Alouette 1, Explorer 20, Alouette 2, and Explorer 31
[NASA-TM-101822] N90-29690
The worldwide ionospheric data base
[NASA-TM-101823] N90-29714
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016128] N90-29964
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations
[NASA-TM-101880] N90-30123
Textual regularities applicable to full text searching: The case of family history literature N90-30125
Accessing network databases via SQL transactions in a multi-model database system
[AD-A223946] N90-30128
Integration of information systems components
[DE90-011761] N90-30136
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations
[NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations
[NASA-TM-89695] N90-30148
Interplanetary medium data book, supplement 4, 1985-1988
[NASA-TM-101867] N90-30149
A guide to the National Space Science Data Center
[NASA-TM-89637] N90-30167
DATA COMPRESSION
Digital color representation
[DE90-014580] N90-29924
Handbook of data compression algorithms
[ESA-TM-06] N90-29969
Image compression
[AD-A224242] N90-29998
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124
DATA CORRELATION
Time series, statistics, and information
[AD-A224317] N90-30018
DATA FLOW ANALYSIS
Communications Interface Driver (CID) software principles of operation
[DOT/FAA/CT-TN89/46] N90-29937
DATA MANAGEMENT
Low cost management of replicated data in fault-tolerant distributed systems
[NASA-CR-186370] N90-29976
External information sources and aerospace R/D: The use and importance of technical reports by US Aerospace engineers and scientists
[NASA-TM-101232] N90-30132
DATA PROCESSING
AutoPAVER: A software package for automated pavement evaluation
[AD-A224176] N90-29531
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
The effect of wave data assimilation on the numerical simulation of wave energy advection
[KNMI-TR-121] N90-29760
An advanced telerobotic system for shuttle payload changeout room processing applications N90-29795
Short encodings of evolving structures
[AD-A223641] N90-29944
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016128] N90-29964
Handbook of data compression algorithms
[ESA-TM-06] N90-29969
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133
IUE-ULDA access guide no. 2. International Ultraviolet Explorer-Uniform Low Dispersion Archive: Comets
[ESA-SP-1134] N90-30157
A search for low energy cosmic ray antiprotons N90-30161
DATA SAMPLING
Sample rate effects on disturbance rejection for digital control systems N90-29400
DATA STORAGE
Theoretical investigations of Pi-conjugated polyradicals as models for organic magnetic materials
[AD-A223411] N90-29461
A high-speed KDL-RAM file system for parallel computers
[AD-A223299] N90-29979
DATA STRUCTURES
Analysis and synthesis of robust data structures
[AD-A224568] N90-30131
DATA SYSTEMS
A guide to the National Space Science Data Center
[NASA-TM-89637] N90-30167
DATA TRANSFER (COMPUTERS)
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
DATA TRANSMISSION
Automated CADAM data transfer: User's manual
[DE90-014871] N90-29963
DEAD RECKONING
Observability of relative navigation using range-only measurements N90-29360
DECISION MAKING
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis
[DE90-008944] N90-29778
What kind of computation is intelligence. A framework for integrating different kinds of expertise N90-29817
Use of graphics in decision aids for telerobotic control: (Parts 5-8 of an 8-part MIT progress report) N90-29829
Coordination in a hierarchical multi-actuator controller N90-29900
Temporal logics meet telerobotics N90-29905
Reactive behavior, learning, and anticipation N90-29908

DECISION THEORY
Problems in probability, statistics, and reliability
[AD-A224152] N90-30016
DECISIONS
Establishing viable task domains for telerobot demonstrations N90-29886
DECODING
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124
DECOMPOSITION
Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484
An additive turbulent decomposition of the Navier-Stokes equations implemented on highly parallel computer systems
[AD-A223678] N90-29595
DEFECTS
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494
Utilization of a measurement process by the examination of universal motors
[ETN-90-97307] N90-29581
Nondestructive material characterization
[DE90-015176] N90-29652
Effective actions for bosonic topological defects
[NASA-CR-187271] N90-30041
Light scattering from surface and sub-surface defects
[DE90-016311] N90-30058
DEFENSE PROGRAM
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350
Database development for the DMSP experiments
[AD-A224346] N90-30129
DEFLECTION
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
DEFORMATION
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
DEGREES OF FREEDOM
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424
The Goddard Space Flight Center (GSFC) robotics technology testbed N90-29825
DELAMINATING
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
DELAY
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
DELAY CIRCUITS
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571
DELAY LINES
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571
DELTA MODULATION
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
DELTA WINGS
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform
[NASA-CR-186226] N90-29381
DEMAGNETIZATION
Investigation of the application in the simulation program 'PSpice' of the Jiles-Atherton model for nonlinear magnetic materials in order to predict the degaussing of magnets
[LINO-1990-1] N90-30029
DEMODULATORS
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
DEMOGRAPHY
The Tempel 2 dust trail
[AD-A224395] N90-30153
DENSITY DISTRIBUTION
Non-destructive evaluation of infiltration-toughened ceramics
[DE90-629716] N90-29501
DENSITY MEASUREMENT
Measurement Techniques for Hypersonic Flows
[VKI-LS-1990-05] N90-29314
CARS spectroscopy and applications N90-29321
Determination of density using simultaneous interferometry methods
[IMFL-90/04] N90-30061
DEPENDENT VARIABLES
A comparison of alternative families of transformations for variables constrained to lie on the interval (0,1)
[MATHS-REPT-A-126] N90-30011
DEPLOYMENT
Shuttle remote manipulator system mission preparation and operations N90-29909
DEPOSITION
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
Transmission electron microscopy study of ICB Al on Ge and Si(001) substrates
[DE90-015299] N90-30103
DESIGN ANALYSIS
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
Aircraft design for mission performance using nonlinear multiobjective optimization methods
[NASA-CR-4328] N90-29384
Assessment and improvement of aeroengine disc structural integrity N90-29392
Robust design of LQG controllers N90-29639
Performance monitoring, fault detection, fault localization design guidance
[AD-A223619] N90-29655
The flight telerobotic servicer Tinman concept: System design drivers and task analysis N90-29822
Discrete-time adaptive control of robot manipulators N90-29834
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
RCTS: A flexible environment for sensor integration and control of robot systems; the distributed processing approach N90-29852
System architectures for telerobotic research N90-29872
Computer simulation and design of a three degree-of-freedom shoulder module N90-29902
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934
DETECTION
Airborne target detection, acquisition, and tracking devices
[AD-A223852] N90-29555
Leak detection aid
[DE90-014678] N90-29616
The Surface Air Sampling Program
[DE90-014873] N90-29711
Light scattering from surface and sub-surface defects
[DE90-016311] N90-30058
New developments in low-energy cosmic gamma-ray detection
[UT-HE-90/07] N90-30165
DETECTORS
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
Detectors and signal processing for the speed measuring system 4-01
[FEL-1989-64] N90-29623
DETONATION
Analysis of pyrotechnic devices by laser-illuminated high speed photography
[DE90-015741] N90-29530
DEUTERIUM COMPOUNDS
Overview of advanced fuel fusion
[DE90-015660] N90-30085
DIAGNOSIS
Diagnostic development and support of MHD test facilities
[DE90-015403] N90-30083
DIAMETERS
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
DIAMONDS
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
Polycrystalline diamond Junction Field Effect Transistors (JFETS)
[AD-A223784] N90-29576
DIESEL FUELS
Investigation of particulate formation during diesel spray combustion
[DE90-012662] N90-29464
DIFFERENCE EQUATIONS
A numerical calculation of hypersonic flow around blunt bodies using upwind difference scheme
[NAL-TR-1025] N90-29331
DIFFERENTIAL EQUATIONS
Applications of differential GPS N90-29349
Trees, bialgebras and intrinsic numerical algorithms
[NASA-CR-187031] N90-29925
An instability theorem for a certain sixth order differential equation
[DE90-627150] N90-29990
Uniform dissipative solutions for some fourth order nonlinear differential equations
[DE90-627151] N90-29991
An existence theorem for periodic solutions and applications to some third order nonlinear differential equations
[DE90-627152] N90-29992
Oscillatory and nonoscillatory behaviour of solutions of an equation alternately of retarded and advanced type
[DE90-627159] N90-29993
Periodic solutions of certain fifth order differential equations
[DE90-627160] N90-29994
Structure of magnetic field in tokamaks
[DE90-628904] N90-30075
DIFFERENTIAL INTERFEROMETRY
Interferometry N90-29315
DIFFUSION
A parallel least squares collocation conjugate gradient approach for the advection diffusion equation
[DE90-015965] N90-29961
Hitting lines with two-dimensional Brownian motion
[AD-A223595] N90-30027
Stochastic properties of the plasma wave heating map
[DE90-508077] N90-30070
DIFFUSION COEFFICIENT
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling
[LR-625] N90-29772
DIFFUSION ELECTRODES
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29466
DIFFUSION FLAMES
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
DIFFUSION WAVES
Photoinduced and holographically reinforced light diffusion in electrooptic crystals
[ETN-90-97321] N90-30060
DIFFUSION WELDING
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions
[BR114894] N90-29646
DIFFUSIVITY
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
DIGITAL COMPUTERS
Control and estimation for aerospace applications with system time delays N90-29367
DIGITAL DATA
Survivable penetration N90-29363
Digital color representation
[DE90-014580] N90-29924
DIGITAL NAVIGATION
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357

DIGITAL SIMULATION
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587
Numerical simulation of the lightning return stroke N90-29743
Investigation of the application in the simulation program 'PSpice' of the Jiles-Atherton model for nonlinear magnetic materials in order to predict the degaussing of magnets
[LINO-1990-1] N90-30029
DIGITAL SYSTEMS
Use of a three-axis monolithic ring laser gyro and digital signal processor in an inertial sensor element N90-29354
Sample rate effects on disturbance rejection for digital control systems N90-29400
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
Fault tolerant design for multistage routing networks
[AD-A224267] N90-29978
DIODES
Long pulse diode experiments
[DE90-016218] N90-29578
DIRAC EQUATION
On Dirac's conjecture for Hamiltonian systems with first and second class constraints
[DE90-627206] N90-30116
DIRECT CURRENT
Theoretical and experimental examinations of brushless monophase direct current motors
[ETN-90-97301] N90-29580
DIRECT LIFT CONTROLS
Evaluation for DLC-Flap Monitoring System of the VSRA
[NAL-TM-607] N90-29391
DIRECTORIES
The worldwide ionospheric data base
[NASA-TM-101823] N90-29714
DISCONTINUITY
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032
DISCRETE FUNCTIONS
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934
Unification of statistical methods for continuous and discrete data
[AD-A224307] N90-30017
DISK OPERATING SYSTEM (DOS)
Turbo pascal implementation of a distributed processing network of MS-DOS microcomputers connected in a master-slave configuration
[AD-A223925] N90-29928
DISKS (SHAPES)
Evaluation of plane-of-light noninterference stress measurement systems for measuring bladed disk vibrations
[AD-A223487] N90-29667
DISPERSING
Microscopic models for electromagnetic wave propagation in highly dispersive media
[AD-A224382] N90-29540
Particle dispersion in a turbulent shear flow
[AD-A224327] N90-29590
DISPLACEMENT
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
DISPLACEMENT MEASUREMENT
Evaluation of plane-of-light noninterference stress measurement systems for measuring bladed disk vibrations
[AD-A223487] N90-29667
DISPLAY DEVICES
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29828
Flight telerobotic servicer control from the Orbiter N90-29882
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016128] N90-29964
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133
DISSIPATION
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
DISTORTION
Microwave background distortions from domain walls
[NASA-CR-187272] N90-29556
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
DISTRIBUTED PARAMETER SYSTEMS
Distributed control architecture for CNI preprocessors N90-29356
A distributed control and monitor system used in laser fusion research
[DE90-011483] N90-30078
DISTRIBUTED PROCESSING
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
RCTS: A flexible environment for sensor integration and control of robot systems; the distributed processing approach N90-29852
Programming your way out of the past: ISIS and the META Project
[NASA-CR-186275] N90-29922
AHTO project: Software technology for open distributed processing
[PB90-190943] N90-29923
Turbo pascal implementation of a distributed processing network of MS-DOS microcomputers connected in a master-slave configuration
[AD-A223925] N90-29928
Supporting large scale applications on networks of workstations
[NASA-CR-186346] N90-29975
Low cost management of replicated data in fault-tolerant distributed systems
[NASA-CR-186370] N90-29976
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977
Knowledge-based expert system configurator
[DE90-011711] N90-30135
DISTRIBUTION (PROPERTY)
Hitting lines with two-dimensional Brownian motion
[AD-A223595] N90-30027
DISTRIBUTION FUNCTIONS
Saddlepoint approximations in conditional inference
[AD-A223280] N90-30000
DITHERS
Ring laser gyro principles and techniques N90-29352
DIURNAL VARIATIONS
Pharmacological resetting of the circadian sleep-wake cycle effects of triazolam on reentrainment of circadian rhythms in a diurnal primate
[AD-A224227] N90-29764
DMSP SATELLITES
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730
Studies of ionospheric dynamics utilizing data from DMSP
[AD-A223370] N90-29733
DOMAIN WALL
Microwave background distortions from domain walls
[NASA-CR-187272] N90-29556
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
DOMINANCE
The t2 dominance of the energy-momentum tensor
[DE90-508027] N90-29544
DOORS
Aircraft evacuations: The effect of passenger motivation and cabin configuration adjacent to the exit
[CAA-PAPER-89019] N90-29336
DOPPLER EFFECT
Laser velocimetry N90-29317
High power oblique incidence HF ionospheric modification
[AD-A224402] N90-29729
DOPPLER RADAR
Observations of tornadoes and wall clouds with a portable FM-CW Doppler radar: 1989--1990 results
[DE90-013152] N90-29752
DOSIMETERS
A tandem system of ionization chambers for effective energy determination of unknown X-radiation fields
[DE90-630463] N90-29405
DOWNWASH
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746
DRAG
Shear-resistant drag reduction polymers. Part 1: Molecular investigations of polymer drag reduction and the development of laboratory screening methods
[AD-A223353] N90-29508
DRAG REDUCTION
Shear-resistant drag reduction polymers. Part 1: Molecular investigations of polymer drag reduction and the development of laboratory screening methods
[AD-A223353] N90-29508
DROPS (LIQUIDS)
Particle dispersion in a turbulent shear flow
[AD-A224327] N90-29590
DUALITY PRINCIPLE
On the manipulability of dual cooperative robots N90-29813
DUCTILITY
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485
Alloy design of ordered intermetallics
[DE90-016031] N90-29490
DUCTS
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
DUST
Interstellar magnetic fields: An observational perspective N90-30144
Dust emission by Comet P/Halley 1982i N90-30159
DYE LASERS
Chemical stabilization of laser dyes
[AD-A224219] N90-29627
Pyrromethene-BF2 complexes as laser dyes
[AD-A223562] N90-29631
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064
DYES
Chemical stabilization of laser dyes
[AD-A224219] N90-29627
DYNAMIC CHARACTERISTICS
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
Thermal imaging assessment
[AD-A224400] N90-29542
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Modeling towed cable system dynamics
[AD-A223610] N90-29644
Studies of ionospheric dynamics utilizing data from DMSP
[AD-A223370] N90-29733
DYNAMIC CONTROL
Dynamic separation: Search for the cause of dynamic stall and search for its control
[AD-A223412] N90-29305
Tip-position control of a flexible beam: Modeling approaches and experimental verification
[AD-A224249] N90-29643
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
Modeling, design, and control of flexible manipulator arms: Status and trends N90-29782
Experiments in cooperative manipulation: A system perspective N90-29812
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
Response to reflected-force feedback to fingers in teleoperations N90-29837
The JAU-JPL anthropomorphic telerobot N90-29838
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
The 3-D vision system integrated dexterous hand N90-29850
Linear analysis of a force reflective teleoperator N90-29856
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Optimal payload rate limit algorithm for zero-G manipulators N90-29858
Recursive multibody dynamics and discrete-time optimal control N90-29860
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877
A control approach for robots with flexible links and rigid end-effectors N90-29879

Preshaping command inputs to reduce telerobotic system oscillations N90-29880
Teleoperation experiments with a Utah/MIT hand and a VPL DataGlove N90-29883
An alternative control structure for telerobotics N90-29889
On discrete control of nonlinear systems with applications to robotics N90-29893
Experimental study on two-dimensional free-flying robot satellite model N90-29896
Computed torque control of a free-flying cooperat ing-arm robot N90-29898
Computer-aided engineering environment for controlled mechanical systems [AD-A223551] N90-29942

DYNAMIC MODELS
State estimation for systems moving through random fields N90-29373
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
Experimental study on the dynamic behavior of a revolving blade grill [REPT-NT-89-CC-18] N90-29604
Tip-position control of a flexible beam: Modeling approaches and experimental verification [AD-A224249] N90-29643
A vector diagram approach to shaping inputs for vibration reduction [AD-A223724] N90-29671
Manipulators with flexible links: A simple model and experiments N90-29786
Direct adaptive control of a PUMA 560 industrial robot N90-29832
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
Preshaping command inputs to reduce telerobotic system oscillations N90-29880
Multi-level manual and autonomous control superposition for intelligent telerobot N90-29888
Symmetry and island structure of the standard map [DE90-508076] N90-30069

DYNAMIC PRESSURE
A comparison of scramjet engine performances of various cycles [NAL-TR-1042] N90-29397
Analysis of scramjet engine characteristics [NAL-TR-1041] N90-29398

DYNAMIC RESPONSE
Analysis of dynamic transient response and postflutter behavior of super-maneuvering airplane [AD-A224126] N90-29386
Computer-aided engineering environment for controlled mechanical systems [AD-A223551] N90-29942

DYNAMIC STABILITY
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
Model based manipulator control N90-29833

DYNAMIC STRUCTURAL ANALYSIS
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15 [AD-A223433] N90-29666
Evaluation of plane-of-light noninterference stress measurement systems for measuring bladed disk vibrations [AD-A223487] N90-29667

DYNAMIC TESTS
Nonlinear modeling of joint dominated structures [NASA-CR-4324] N90-29423

E

EARTH CRUST
Some aspects of the structure and evolution of oceanic spreading centers N90-29757

EARTH IONOSPHERE
The worldwide ionospheric data base [NASA-TM-101823] N90-29714
High power oblique incidence HF ionospheric modification [AD-A224402] N90-29729
Studies of ionospheric dynamics utilizing data from DMSP [AD-A223370] N90-29733
Atmospheric structure and variability [AD-A223439] N90-29734
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves [AD-A223685] N90-29738

EARTH MAGNETOSPHERE
A study of magnetic field reconnection and plasma processes in the magnetosphere [DE90-016117] N90-29741

EARTH SURFACE
Thermal imaging assessment [AD-A224400] N90-29542

EARTHQUAKES
Catalog of strong motion stations in Eastern North America [PB90-251984] N90-29722

ECCENTRICITY
Rotordynamic properties of high pressure seals: An experimental approach N90-29640

ECONOMIC ANALYSIS
Airline productivity relating on the fuel cost. (2): Fuel consumption values and fuel efficiency [NAL-TM-604-2] N90-29333

ECONOMY
The cost of air service fragmentation [TT-9010] N90-29334

EDDY CURRENTS
Neural nets and eddy-current testing [DE90-016044] N90-29656

EDGE DETECTION
Trinocular stereovision using figural continuity, dealing with curved objects N90-29802

EDGES
Symmetrical layered thin film edge field-emitter-array and method for its production [AD-D014594] N90-29589
An investigation of hole-edge crack problem by a combined complex variable and least square method [LR-626] N90-29679

EDUCATION
Workshop on Low Level Flight Training [AGARD-AR-288] N90-29404
Strategies for tutoring multiple bugs [AD-A223921] N90-29927
Search strategies for computer-stored information: A microcomputer tutorial N90-30126

EIGENVALUES
Fast algorithms for parallel architectures [AD-A223731] N90-29947
Solution of nonlinear eigenvalue problems via parallel shooting [LR-587] N90-30013

EIGENVECTORS
Active vibration damping of flexible structures [DLR-FB-90-03] N90-29676
Fast algorithms for parallel architectures [AD-A223731] N90-29947
Solution of nonlinear eigenvalue problems via parallel shooting [LR-587] N90-30013

ELASTIC CYLINDERS
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658

ELASTIC DAMPING
Research into traveling wave control in flexible structures [AD-A224504] N90-29661

ELASTIC DEFORMATION
Analysis of dynamic transient response and postflutter behavior of super-maneuvering airplane [AD-A224126] N90-29386
The overall response of composite materials undergoing large elastic deformations [AD-A224509] N90-29439
Studies on crack mechanics [AD-A223634] N90-29670
Comparison of crack closure result obtained by 3D elastic-plastic FEM and modified Dugdale model [FFA-TN-1990-18] N90-29675

ELASTIC PLATES
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658

ELASTIC PROPERTIES
Surface effect for test piece on flexural test of carbon fiber reinforced plastic laminates [NAL-TM-601] N90-29436
Percolation and low density materials: Theory and applications [AD-A224237] N90-29438
Tip-position control of a flexible beam: Modeling approaches and experimental verification [AD-A224249] N90-29643

ELASTOMERS
Compatibility of elastomeric seal compounds with MIL-H-6083 and MIL-H-46170 hydraulic fluid [AD-A224248] N90-29504
Rheology of filler rubber: Silica-silicone [AD-A223600] N90-29511
Effect of particulate fillers on the rheology of polymer melts [AD-A223601] N90-29512

ELASTOMETERS
The optimum polymer binder for pressable high performance explosives: A preliminary evaluation [ETN-90-97612] N90-29524

ELECTRIC BATTERIES
The nuclear battery [DE90-630400] N90-29559

ELECTRIC BRIDGES
Evaluation of a thermistor power measurement system for use on the NPL antenna extrapolation range [NPL-DES-89] N90-29583

ELECTRIC CHARGE
Pulsed field sample neutralization [DE90-015131] N90-29452

ELECTRIC CONTACTS
Application of a rechargeable, small caliber railgun power supply [AD-A224207] N90-29418

ELECTRIC CURRENT
Magnetic surfaces in tokamaks [DE90-628905] N90-30076

ELECTRIC EQUIPMENT TESTS
Evaluation for DLC-Flap Monitoring System of the VSRA [NAL-TM-607] N90-29391

ELECTRIC FIELDS
Satellite measurements of magnetospheric Poynting flux [AD-A224391] N90-29724
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes [AD-A224397] N90-29727
Studies of ionospheric dynamics utilizing data from DMSP [AD-A223370] N90-29733
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interactions [AD-A224282] N90-30065

ELECTRIC IGNITION
Electrical ignition of HAN-based liquid propellants [AD-A223272] N90-29528

ELECTRIC MOTORS
Performance test plan for variable-speed ac superconducting motor [DE90-016208] N90-29579
Theoretical and experimental examinations of brushless monophase direct current motors [ETN-90-97301] N90-29580

ELECTRIC POTENTIAL
Pulsed field sample neutralization [DE90-015131] N90-29452

ELECTRIC POWER SUPPLIES
Practical superconductor development for electrical power applications [DE90-014836] N90-30109

ELECTRIC PROPULSION
Application of a rechargeable, small caliber railgun power supply [AD-A224207] N90-29418

ELECTRICAL ENGINEERING
Performance analysis of subspace-based parameter estimation algorithms [AD-A224523] N90-29566

ELECTRICAL MEASUREMENT
Evaluation of a thermistor power measurement system for use on the NPL antenna extrapolation range [NPL-DES-89] N90-29583

ELECTRICAL PROPERTIES
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests [NAL-TR-1040] N90-29657
A study of water vapor, electrical parameters, and radio propagation [AD-A223582] N90-29736

ELECTRO-OPTICS
Electro-optics engineering support for the integrated launch and recovery television surveillance system [AD-A223450] N90-29406
Parallel architectures and algorithms for image understanding [AD-A223479] N90-29940
Special purpose spatial light modulators [AD-A223794] N90-30052
Comparison of electro-optic diagnostic systems [DE90-015619] N90-30056
Photoinduced and holographically reinforced light diffusion in electrooptic crystals [ETN-90-97321] N90-30060

Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064

ELECTROCHEMISTRY
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29486
Non-destructive method for environmental breakdown of graphite fiber reinforced polymer composites
[AD-A223729] N90-29515
Electrochemical characteristics of acid electrolytes for fuel cells
[PB90-244385] N90-29693
Advanced materials and electrochemical processes in high-temperature solid electrolytes
[DE90-015552] N90-30104

ELECTRODEPOSITION
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
Effects of low Chromium(3) concentration in electrodeposition of low contraction chromium
[AD-A223338] N90-29477

ELECTRODES
A tandem system of ionization chambers for effective energy determination of unknown X-radiation fields
[DE90-630463] N90-29405
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
Realization of equipment for manufacturing titanium alloy electrodes for first step melting
[ONERA-RT-15/3578-M] N90-29498
Electrical ignition of HAN-based liquid propellants
[AD-A223272] N90-29528
Advanced materials and electrochemical processes in high-temperature solid electrolytes
[DE90-015552] N90-30104

ELECTROENCEPHALOGRAPHY
Physiological metrics of mental workload: A review of recent progress
[NASA-CR-187290] N90-29777

ELECTROLYTE METABOLISM
Renal response to seven days of lower body positive pressure in the squirrel monkey
[NASA-CR-183355] N90-29761

ELECTROLYTES
Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes
[DE90-016626] N90-29699

ELECTROLYTIC CELLS
Electrochemical characteristics of acid electrolytes for fuel cells
[PB90-244385] N90-29693
Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes
[DE90-016626] N90-29699

ELECTROMAGNETIC ABSORPTION
Laser induced fluorescence imaging applications
N90-29322

ELECTROMAGNETIC FIELDS
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29588
An x ray source for lithography
[AD-D014596] N90-29630
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765

ELECTROMAGNETIC INTERACTIONS
The f2 dominance of the energy-momentum tensor
[DE90-508027] N90-29544

ELECTROMAGNETIC MEASUREMENT
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
[AD-A224239] N90-29538

ELECTROMAGNETIC NOISE
Novel approaches to sensitivity enhancement of ring laser gyros
[AD-A224335] N90-29617

ELECTROMAGNETIC PULSES
Microscopic models for electromagnetic wave propagation in highly dispersive media
[AD-A224382] N90-29540

ELECTROMAGNETIC WAVE FILTERS
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571

ELECTROMAGNETIC WAVE TRANSMISSION
Microscopic models for electromagnetic wave propagation in highly dispersive media
[AD-A224382] N90-29540
Specification for a standard electromagnetic propagation model
[AD-A223556] N90-29551

ELECTROMAGNETISM
Application of a rechargeable, small caliber railgun power supply
[AD-A224207] N90-29418

ELECTROMIGRATION
VLSI design for reliability
[AD-A224264] N90-29562

ELECTRON BEAMS
Electron-beam fluorescence measurements in hypersonic flows N90-29318
Electron beam for velocity determination N90-29319
Microstructure of alpha-Al base matrix/SiC particulate composites
[DE90-014894] N90-29449
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Long pulse diode experiments
[DE90-016218] N90-29578
Establishment of a capability to measure optical transition radiation
[AD-A224094] N90-30047
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interactions
[AD-A224282] N90-30065

ELECTRON CYCLOTRON HEATING
High average power CW FELS (Free Electron Laser) for application to plasma heating: Designs and experiments
[DE90-011085] N90-29633

ELECTRON DENSITY (CONCENTRATION)
The II-VI semiconductor superlattices
[AD-A223748] N90-30101
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106

ELECTRON DENSITY PROFILES
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves
[AD-A223685] N90-29738

ELECTRON DIFFRACTION
Scanning tunneling microscopy studies of chemisorbed layers on metal surfaces
[DE90-015623] N90-29486

ELECTRON EMISSION
Symmetrical layered thin film edge field-emitter-array and method for its production
[AD-D014594] N90-29569

ELECTRON ENERGY
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494

ELECTRON MICROSCOPY
Scanning tunneling microscopy studies of chemisorbed layers on metal surfaces
[DE90-015623] N90-29486
Fractographic analysis of fatigue crack growth under two-blocks loading on 2024-T351 sheet specimens
[LR-628] N90-29680
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
Transmission electron microscopy study of ICB Al on Ge and Si(001) substrates
[DE90-015299] N90-30103
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108

ELECTRON MOBILITY
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720

ELECTRON PARAMAGNETIC RESONANCE
An electron spin resonance study of adsorbed gases in ultrahigh vacuum
[ETN-90-97323] N90-29469

ELECTRON PLASMA
High average power CW FELS (Free Electron Laser) for application to plasma heating: Designs and experiments
[DE90-011085] N90-29633

ELECTRON SCATTERING
Medium energy nuclear physics research
[DE90-015852] N90-30042
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106

ELECTRON SPECTROSCOPY
Electrochemistry of metal surfaces
[AD-A224551] N90-29458

ELECTRON STATES
Theory of electronic states and formation energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093

ELECTRONIC EQUIPMENT
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed
[AD-A223446] N90-29549
Proceedings of the 14th Annual Electronics Manufacturing Seminar
[AD-A224276] N90-29563
Reliability study of TWT output RF window
[AD-A223688] N90-29574
Transport of nonneutral plasmas
[AD-A223457] N90-30077

ELECTRONIC MODULES
High frequency bundle protection
[DIGEL-1990-1] N90-29582

ELECTRONS
Symmetrical layered thin film edge field-emitter-array and method for its production
[AD-D014594] N90-29569
New real space correlated-basis-functions approach for the electron correlations of the semiconductor inversion layer
[DE90-627315] N90-30090

ELECTROPOLISHING
Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484

ELECTROSTATIC WAVES
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interactions
[AD-A224282] N90-30065

ELECTROSTRICTION
Piezoelectric and electrostrictive materials for transducer applications, volume 1
[AD-A223560] N90-29668
Piezoelectric and electrostrictive materials for transducer applications, volume 2
[AD-A223561] N90-29669

ELEMENTARY PARTICLES
Higher order equations of motion
[DE90-627522] N90-30038

ELEVATORS (CONTROL SURFACES)
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399

ELLIPTIC DIFFERENTIAL EQUATIONS
Elliptic grid generation N90-29612

EMBRITTLEMENT
Alloy design of ordered intermetallics
[DE90-016031] N90-29490
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493

EMISSION SPECTRA
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099

EMISSIVITY
Thermal imaging assessment
[AD-A224400] N90-29542

EMITTERS
Symmetrical layered thin film edge field-emitter-array and method for its production
[AD-D014594] N90-29569
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040

EMOTIONAL FACTORS
Optimism and cardiovascular reactivity to psychological and cold pressor stress
[AD-A223818] N90-29771
Coping strategies and mood during cold weather training
[AD-A223915] N90-29773

EMOTIONS
Ability and metacognitive determinants of skill acquisition and transfer
[AD-A224569] N90-29776

EMULSIONS
Toughening of SAN copolymers by an SAN emulsion grafted rubber
[AD-A224213] N90-29502
END EFFECTORS
Autonomous dexterous end-effectors for space robotics N90-29788
Design and control of a multi-fingered robot hand provided with tactile feedback N90-29789
Force/torque and tactile sensors for sensor-based manipulator control N90-29791
Redundant sensorized arm+hand system for space telerobotized manipulation N90-29792
Modeling and sensory feedback control for space manipulators N90-29807
The 3-D vision system integrated dexterous hand N90-29850
A control approach for robots with flexible links and rigid end-effectors N90-29879
Integration of a sensor based multiple robot environment for space applications: The Johnson Space Center Teleoperator Branch Robotics Laboratory N90-29890
Dexterous manipulator flight demonstration N90-29911
ENERGY BUDGETS
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702
ENERGY CONSERVATION
The technology transfer process: Background for the national energy strategy
[DE90-015301] N90-30139
ENERGY CONSUMPTION
Comparison of joint space versus task force load distribution optimization for a multiarm manipulator system N90-29873
ENERGY CONVERSION EFFICIENCY
Basic studies of 3-V high efficiency cell components
[DE90-000360] N90-29696
ENERGY DISSIPATION
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724
ENERGY LEVELS
Monte Carlo simulation of complex spectra for opacity calculations
[DE90-015198] N90-30147
ENERGY SPECTRA
A search for low energy cosmic ray antiprotons N90-30161
ENERGY STORAGE
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
ENERGY TECHNOLOGY
Some studies related to a new Hexagonal Compound Parabolic Concentrator (HCPC) as a secondary in tandem with a solar tower
[DLR-FB-90-12] N90-29700
ENERGY TRANSFER
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
ENGINE AIRFRAME INTEGRATION
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397
Analysis of scramjet engine characteristics
[NAL-TR-1041] N90-29398
ENGINE NOISE
Audibility and annoyance of en route noise of unducted fan engines
[AD-A223687] N90-30035
ENTROPY (STATISTICS)
Unification of statistical methods for continuous and discrete data
[AD-A224307] N90-30017
Time series, statistics, and information
[AD-A224317] N90-30018
ENVIRONMENT EFFECTS
Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
Effects of increased CO2 on forest response
[DE90-015406] N90-29708
Assessment System for Aircraft Noise (ASAN): Development of alpha-test prototype system software
[AD-A223770] N90-30036
ENVIRONMENT MANAGEMENT
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704
Environmental quality, 1970 - 1990
[PB90-214610] N90-29705
ENVIRONMENT POLLUTION
Environmental quality, 1970 - 1990
[PB90-214610] N90-29705
ENVIRONMENT PROTECTION
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
ENVIRONMENTAL MONITORING
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712
ENVIRONMENTAL QUALITY
Environmental quality, 1970 - 1990
[PB90-214610] N90-29705
ENVIRONMENTAL TESTS
Effect of environment upon mechanical behavior of structural ceramics for application in the DOE ceramic technology for advanced heat engines project
[DE90-014770] N90-29500
EPITAXY
Microscopic aspects of the initial stages of epitaxial growth. A scanning tunneling microscopy study
[AD-A224325] N90-30094
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095
The II-VI semiconductor superlattices
[AD-A223748] N90-30101
EQUATIONS OF MOTION
Tip-position control of a flexible beam: Modeling approaches and experimental verification
[AD-A224249] N90-29643
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
Windshear estimation along the trajectory of an aircraft N90-29745
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746
Recursive multibody dynamics and discrete-time optimal control N90-29860
The effects of gear reduction on robot dynamics N90-29861
On equations of motion on complex Grassman manifold
[DE90-628369] N90-29999
A canonical integration technique of arbitrary order
[DE90-628377] N90-30025
Higher order equations of motion
[DE90-627522] N90-30038
Effective actions for bosonic topological defects
[NASA-CR-187271] N90-30041
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064
EQUATIONS OF STATE
Statistically designed study of the variables and parameters of carbon dioxide equations of state
[DE90-016196] N90-29467
Robust design of LQG controllers N90-29639
Innovative uses of parallel computers
[AD-A223578] N90-29980
Nucleus-nucleus collisions and the nuclear equation of state
[DE90-015427] N90-30037
EQUATORIAL ATMOSPHERE
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves
[AD-A223685] N90-29738
EQUILIBRIUM EQUATIONS
Three dimensional studies of helical equilibria and magnetic surface breaking due to the finite beta effect
[DE90-508078] N90-30071
EROSION
Solid particle erosion in turbulent flows past tube banks
[DE90-015711] N90-29598
ERROR ANALYSIS
Theoretical specifications of the trajectory estimation for a space navigation system with the function of guidance and control
[NAL-TR-1032] N90-29420
Robust design of LQG controllers N90-29639
Analytic least squares
[NPL-DES-86] N90-29971
A posteriori error estimates for parametrized nonlinear equations
[AD-A224067] N90-29997
Survey of formal specification techniques for reactive systems
[AD-A223741] N90-30005
Sensitivity of the error in multivariate statistical interpolation to parameter values
[AD-A224076] N90-30015
An error estimate for Tremolieres method for the discretization of parabolic variational inequalities
[DE90-627169] N90-30024
ERROR CORRECTING CODES
Analysis of the integrity of the Microwave Landing System (MLS) data functions N90-29365
Integrating rule-based and neural-net techniques for spectral analysis
[AD-A223517] N90-29462
ERROR DETECTION CODES
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
ERRORS
Performance monitoring, fault detection, fault localization design guidance
[AD-A223619] N90-29655
Human error classification and data collection
[DE90-631408] N90-29915
ESTIMATES
Estimation and representation of multidimensional mappings
[DLR-MITT-90-06] N90-29967
ESTIMATING
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
Windshear estimation along the trajectory of an aircraft N90-29745
EULER EQUATIONS OF MOTION
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327
Calculation of flow fields by the solution of the Euler equations using an extended finite volume discretization scheme
[ESA-TT-1204] N90-29605
Recursive Newton-Euler formulation of manipulator dynamics N90-29862
EUROPEAN COMMUNICATIONS SATELLITE
ECS: Sixth year in orbit
[ESA-BR-70] N90-29428
EUROPEAN SPACE AGENCY
ESA's report to the 28th COSPAR meeting
[ESA-SP-1124] N90-30141
Activities report of the Space Science Department
[ESA-SP-1126] N90-30142
Activities report of the European Space Agency
[ISSN-0258-025X] N90-30169
EUROPEAN SPACE PROGRAMS
An introductory guide preparing to use the ESTEC environmental test facilities
[ESA-TM-05] N90-29419
ESA's report to the 28th COSPAR meeting
[ESA-SP-1124] N90-30141
Activities report of the Space Science Department
[ESA-SP-1126] N90-30142
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
Activities report of the European Space Agency
[ISSN-0258-025X] N90-30169
EUROPIUM ISOTOPES
Examinations of hyperfine structure and isotope displacement of the elements gadolinium and europium with laser fluorescence and two photon spectroscopy
[ETN-90-97312] N90-29488
EUTECTICS
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
EVACUATING (TRANSPORTATION)
Aircraft evacuations: The effect of passenger motivation and cabin configuration adjacent to the exit
[CAA-PAPER-89019] N90-29336
EVENT HORIZON
Information loss down a black hole
[DE90-627482] N90-30154
EVOLUTION (DEVELOPMENT)
Some aspects of the structure and evolution of oceanic spreading centers N90-29757
EXCITATION
Model calculations for a 600 angstrom laser based on photopumping of Mo(sup 6+) by a spectral line of Mo(sup 11+)
[DE90-015002] N90-29634
EXCITONS
Nonlinear optical studies of the optical and electronic properties of semiconductor heterostructures
[AD-A223408] N90-30096

Optical nonlinearity due to structure defects and bistability in the band discontinuity area of CdS
[ETN-90-97303] N90-30112
EXHAUST GASES
Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
EXHAUST NOZZLES
Calibration of the PARC program for propulsion-type flows
[AD-A224253] N90-29395
EXISTENCE THEOREMS
An existence theorem for periodic solutions and applications to some third order nonlinear differential equations
[DE90-627152] N90-29992
EXOSAT SATELLITE
ESA's report to the 28th COSPAR meeting
[ESA-SP-1124] N90-30141
EXPERT SYSTEMS
Integrating rule-based and neural-net techniques for spectral analysis
[AD-A223517] N90-29462
Information management in an integrated space telerobot N90-29846
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
Determining robot actions for tasks requiring sensor interaction N90-29868
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
Multi-level manual and autonomous control superposition for intelligent telerobot N90-29888
Coordination in a hierarchical multi-actuator controller N90-29900
Distributed communications and control network for robotic mining N90-29901
Generic task problem solvers in Soar N90-29904
Optical symbolic processor for expert system execution
[AD-A224284] N90-29931
An analysis of the distinction between deep and shallow expert systems
[AD-A224443] N90-29987
Knowledge-based expert system configurator
[DE90-011711] N90-30135
EXPLORER 20 SATELLITE
Results from Alouette 1, Explorer 20, Alouette 2, and Explorer 31
[NASA-TM-101822] N90-29690
EXPLORER 31 SATELLITE
Results from Alouette 1, Explorer 20, Alouette 2, and Explorer 31
[NASA-TM-101822] N90-29690
EXPONENTIAL FUNCTIONS
Classical and Bayes-P subset selection procedures for double exponential populations
[AD-A223830] N90-30006
EXPOSURE
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
EXTRATERRESTRIAL ENVIRONMENTS
Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
EXTRATERRESTRIAL RADIATION
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
EXTRAVEHICULAR ACTIVITY
The astronaut and the banana peel: An EVA retriever scenario N90-29897
Preliminary hazard analysis in design application to EVA space suit
[ETN-90-97585] N90-29918

F

F REGION
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
F-15 AIRCRAFT
Application of multifunction inertial reference systems to fighter aircraft N90-29341
Integrated navigation/flight control for future high performance aircraft N90-29362
FABRICATION
A tandem system of ionization chambers for effective energy determination of unknown X-radiation fields
[DE90-630463] N90-29405
Studies of surface heat transfer in an arc-heated wind tunnel
[NAL-TR-1048] N90-29410
Two terminal CuInSe2 based cascade cells
[DE90-000363] N90-29697
A review of manganin gauge technology for measurements in the gigapascal range
[MRL-TR-90-5] N90-30026
Practical superconductor development for electrical power applications
[DE90-014836] N90-30109
FAIL-SAFE SYSTEMS
Software design for high integrity systems
[ETN-90-97517] N90-29966
FAILURE
Assessment and improvement of aeroengine disc structural integrity N90-29392
Reliability study of TWT output RF window
[AD-A223688] N90-29574
FAILURE ANALYSIS
Techniques for autonomous GPS integrity monitoring N90-29345
A low cost inertial/GPS integrated approach to land navigation N90-29374
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap
[NAL-TR-1047] N90-29686
Using minimal spanning trees to compare the reliability of network topologies
[NASA-TM-4208] N90-30014
FALLOUT
The Surface Air Sampling Program
[DE90-014873] N90-29711
FAR INFRARED RADIATION
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100
FAST NEUTRONS
Emission of quick neutrons and non-equilibrium phenomena by central shocks in the reaction 40 Ar + 40 Ca at 20 MeV/u
[ETN-90-97296] N90-30043
FATIGUE (MATERIALS)
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
Fractographic analysis of fatigue crack growth under two-blocks loading on 2024-T351 sheet specimens
[LR-629] N90-29680
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683
Fractographic observations on fatigue crack growth under miniTWIST flight-simulation loading (2024-T3 material)
[LR-631] N90-29684
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap
[NAL-TR-1047] N90-29686
FATIGUE LIFE
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
FATIGUE TESTS
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Fractographic observations on fatigue crack growth under miniTWIST flight-simulation loading (2024-T3 material)
[LR-631] N90-29684
FAULT TOLERANCE
A single wafer bit-sliced convolver: An optimum statistical solution for the implementation of redundancy
[REPT-89-019] N90-29584
Formal design and verification of a reliable computing platform for real-time control. Phase 1: Results
[NASA-TM-102716] N90-29965
Low cost management of replicated data in fault-tolerant distributed systems
[NASA-CR-186370] N90-29976
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977
Fault tolerant design for multistage routing networks
[AD-A224267] N90-29978
FAULT TREES
Techniques for developing a system safety risk assessment model
[AD-A223477] N90-29654
Using minimal spanning trees to compare the reliability of network topologies
[NASA-TM-4208] N90-30014
FAULTS
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
FEASIBILITY
Studies of surface heat transfer in an arc-heated wind tunnel
[NAL-TR-1048] N90-29410
FEASIBILITY ANALYSIS
Feasibility of the temperature measurements in hypersonic flow by multibeam coherent Raman anti-Stokes scattering
[ONERA-RF-56/7131-PY] N90-29312
FEDERAL BUDGETS
NASA authorization, 1991, volume 2
[GPO-32-196] N90-30138
FEEDBACK
Performance constraints and compensation for teleoperation with delay N90-29881
FEEDBACK AMPLIFIERS
Image amplification in photoreactive crystals and utilization in optical reaction systems
[ETN-90-97285] N90-30059
FEEDBACK CONTROL
Control and estimation for aerospace applications with system time delays N90-29367
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399
Sample rate effects on disturbance rejection for digital control systems N90-29400
A three axis attitude control of a satellite
[NASDA-TR-22] N90-29421
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424
Robust design of LQG controllers N90-29639
Robots, systems, and flexible automation
[DE90-015802] N90-29649
Design and control of a multi-fingered robot hand provided with tactile feedback N90-29789
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
Modeling and sensory feedback control for space manipulators N90-29807
Experiments in cooperative manipulation: A system perspective N90-29812
Linear analysis of a force reflective teleoperator N90-29856
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Performance constraints and compensation for teleoperation with delay N90-29881
MacRootLocus: A CAD design tool for feedback control systems
[AD-A223772] N90-29951
FEEDFORWARD CONTROL
Manipulators with flexible links: A simple model and experiments N90-29786
Performance constraints and compensation for teleoperation with delay N90-29881
FERRITES
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
Activities of the Division of Microwave Technology
[FOA-C-30555-3.2] N90-29537
FERROMAGNETIC MATERIALS
Theoretical investigations of Pi-conjugated polyradicals as models for organic magnetic materials
[AD-A223411] N90-29461

FIBER COMPOSITES
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming
[LR-621] N90-29451
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503
FIBER OPTICS
Inertial grade fiber gyros N90-29353
Development and evaluation of hermetic laser diode ignited pyrotechnic components
[DE90-015745] N90-29529
Evaluation of a potential Wave Division Multiplexer (WDM) for use in the IRSTD
[AD-A223945] N90-29560
High speed bus technology development
[AD-A224486] N90-29565
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
FIBER ORIENTATION
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503
FIELD EFFECT TRANSISTORS
High throughput MBE materials for MODFET's
[AD-A223452] N90-30097
The II-VI semiconductor superlattices
[AD-A223748] N90-30101
Extended characterization of the damage by hot charge carriers in gate oxide by short channel MOS field effect transistors
[ETN-90-97313] N90-30114
FIELD STRENGTH
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing
[AD-A224510] N90-29543
Interstellar magnetic fields: An observational perspective N90-30144
FIELD THEORY (PHYSICS)
Brorfelde Geomagnetic Observatory: Magnetic results, 1987
[ISBN-87-7478-297-5] N90-29756
Higher order equations of motion
[DE90-627522] N90-30038
On Dirac's conjecture for Hamiltonian systems with first and second class constraints
[DE90-627206] N90-30116
A new vector-tensor theory and higher-dimensional cosmology
[DE90-507990] N90-30117
Introductory lectures on conformal field theory and strings
[DE90-627219] N90-30120
FIGHTER AIRCRAFT
Fighter agility metrics
[NASA-CR-187289] N90-29389
FILLERS
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
FILM COOLING
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
FILTRATION
Effect of particulate fillers on the rheology of polymer melts
[AD-A223601] N90-29512
Estimation and representation of multidimensional mappings
[DLR-MITT-90-06] N90-29967
FINGERS
Response to reflected-force feedback to fingers in teleoperations N90-29837
FINITE DIFFERENCE THEORY
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302
Finite difference modeling of laser diode ignited components
[DE90-015652] N90-29635
Parallelization of a method for solving three dimensional Navier-Stokes equations on a distributed memory multiprocessor
[ONERA-RTS-1/3717-CY] N90-29983
FINITE ELEMENT METHOD
A package for 3-D unstructured grid generation, finite-element flow solution and flow field visualization
[NASA-CR-182090] N90-29309
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
Assessment and improvement of aeroengine disc structural integrity N90-29392
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437
Reliability study of TWT output RF window
[AD-A223688] N90-29574
Dual and primal mixed Petrov-Galerkin finite element methods in heat transfer problems
[DE90-627190] N90-29592
Optimization of tetrahedrical meshes for finite element calculation methods in fluids mechanics
[ETN-90-97560] N90-29603
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
Tip-position control of a flexible beam: Modeling approaches and experimental verification
[AD-A224249] N90-29643
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
The ACR-program for automatic finite element model generation for part through cracks
[DE90-631545] N90-29682
Comparison of crack closure result obtained by 3D elastic-plastic FEM and modified Dugdale model
[FFA-TN-1990-18] N90-29675
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
A posteriori error estimates for parametrized nonlinear equations
[AD-A224067] N90-29997
FINITE VOLUME METHOD
Calculation of flow fields by the solution of the Euler equations using an extended finite volume discretization scheme
[ESA-TT-1204] N90-29605
The fundamentals of adaptive grid movement N90-29610
FIRE CONTROL
Application of multifunction inertial reference systems to fighter aircraft N90-29341
FISHES
Exogenous and endogenous control of activity behavior and the fitness of fish
[DLR-FB-90-14] N90-29766
FISSION PRODUCTS
The Surface Air Sampling Program
[DE90-014873] N90-29711
FLAME SPECTROSCOPY
Spectroscopy of propellant-related flames
[AD-A224088] N90-29525
FLAME TEMPERATURE
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
FLAMES
CARS spectroscopy and applications N90-29321
FLAMMABILITY
Tests for aircraft interior materials in fire accident
[LR-622] N90-29337
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
FLAT PLATES
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
Bistatic radar cross section of a perfectly conducting rhombus-shaped flat plate
[AD-A223418] N90-29546
FLEXIBILITY
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Active vibration damping of flexible structures
[DLR-FB-90-03] N90-29676
Modeling, design, and control of flexible manipulator arms: Status and trends N90-29782
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
Technology and task parameters relating to the effectiveness of the bracing strategy N90-29785
Experiments in identification and control of flexible-link manipulators N90-29787
Design and control of a multi-fingered robot hand provided with tactile feedback N90-29789
FLEXIBLE BODIES
Tip-position control of a flexible beam: Modeling approaches and experimental verification
[AD-A224249] N90-29643
Research into traveling wave control in flexible structures
[AD-A224504] N90-29661
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
FLIGHT CHARACTERISTICS
Application of multifunction inertial reference systems to fighter aircraft N90-29341
Fighter agility metrics
[NASA-CR-187289] N90-29389
FLIGHT CONTROL
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
Application of multifunction inertial reference systems to fighter aircraft N90-29341
Integrated navigation/flight control for future high performance aircraft N90-29362
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
Fighter agility metrics
[NASA-CR-187289] N90-29389
Formal design and verification of a reliable computing platform for real-time control. Phase 1: Results
[NASA-TM-102716] N90-29965
FLIGHT ENVELOPES
Application of multifunction inertial reference systems to fighter aircraft N90-29341
FLIGHT PLANS
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
FLIGHT RULES
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350
FLIGHT SIMULATION
Fighter agility metrics
[NASA-CR-187289] N90-29389
Workshop on Low Level Flight Training
[AGARD-AR-288] N90-29404
Terrain visual cue analysis for simulating low-level flight: A multidimensional scaling approach
[AD-A223564] N90-29407
Fractographic observations on fatigue crack growth under miniTWIST flight-simulation loading (2024-T3 material)
[LR-631] N90-29684
FLIGHT SIMULATORS
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
FLIGHT TEST INSTRUMENTS
Evaluation for DLC-Flap Monitoring System of the VSRA
[NAL-TM-607] N90-29391
FLIGHT TESTS
Ring laser gyro principles and techniques N90-29352
High altitude balloon flight test of the GRAD experiment
[AD-A224396] N90-29388
Fighter agility metrics
[NASA-CR-187289] N90-29389
Evaluation for DLC-Flap Monitoring System of the VSRA
[NAL-TM-607] N90-29391
Procedure for calibrating fly-by-wire control chains of the flying testbed ATTAS
[DLR-MITT-90-02] N90-29401
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
Dexterous manipulator flight demonstration N90-29911
A search for low energy cosmic ray antiprotons N90-30161
FLIGHT TRAINING
Workshop on Low Level Flight Training
[AGARD-AR-288] N90-29404
FLOATING POINT ARITHMETIC
Formal verification of mathematical software, volume 2
[AD-A223633] N90-29943
FLOW CHARACTERISTICS
Electron-beam fluorescence measurements in hypersonic flows N90-29318

Determination of density using simultaneous interferometry methods
[IMFL-90/04] N90-30061
FLOW DISTORTION
Experimental study on the dynamic behavior of a revolving blade grill
[REPT-NT-89-CC-18] N90-29604
FLOW DISTRIBUTION
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302
A package for 3-D unstructured grid generation, finite-element flow solution and flow field visualization
[NASA-CR-182090] N90-29309
Calculation of turbulent air streams in driver cabs
[ETN-90-97320] N90-29310
Measurement Techniques for Hypersonic Flows
[VKI-LS-1990-05] N90-29314
Interferometry N90-29315
Velocity interferometry N90-29316
Laser velocimetry N90-29317
Electron-beam fluorescence measurements in hypersonic flows N90-29318
Applications of LIF to high speed flows N90-29320
Laser induced fluorescence imaging applications N90-29322
Laser induced fluorescence: Practical applications N90-29323
A numerical calculation of hypersonic flow around blunt bodies using upwind difference scheme
[NAL-TR-1025] N90-29331
Experimental study on the dynamic behavior of a revolving blade grill
[REPT-NT-89-CC-18] N90-29604
Calculation of flow fields by the solution of the Euler equations using an extended finite volume discretization scheme
[ESA-TT-1204] N90-29605
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
FLOW EQUATIONS
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
Numerical simulation supersonic free shear layers
[AD-A223771] N90-29306
Barotropic mechanisms associated with tropical plume formation N90-29719
FLOW MEASUREMENT
Measurement Techniques for Hypersonic Flows
[VKI-LS-1990-05] N90-29314
Interferometry N90-29315
Experimental study on the dynamic behavior of a revolving blade grill
[REPT-NT-89-CC-18] N90-29604
FLOW RESISTANCE
A numerical study of the response of the laminar unsteady separated flow about a circular cylinder to changes of boundary conditions
[DLR-FB-90-10] N90-29613
FLOW STABILITY
Unstable phenomena in mechanical systems
[AD-A223640] N90-30001
FLOW VELOCITY
Velocity interferometry N90-29316
Electron beam for velocity determination N90-29319
Laser induced fluorescence: Practical applications N90-29323
Analysis of scramjet engine characteristics
[NAL-TR-1041] N90-29398
Technique for the measurement of noise of the flow associated to the small wave numbers of the turbulence spectra
[ETN-90-97558] N90-29601
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling
[LR-625] N90-29772
FLOW VISUALIZATION
Applications of LIF to high speed flows N90-29320
Laser induced fluorescence: Practical applications N90-29323
Numerical Grid Generation
[VKI-LS-1990-06] N90-29606
FLUID DYNAMICS
Thermal transfers in unsteady compressible inviscid flow
[ETN-90-97557] N90-29311
Theoretical study of the interaction between an oblique shock wave and a turbulent boundary layer from a heated wall
[ONERA-RSF-87/7078/AY-100-A] N90-29313
The development and evaluation of numerical algorithms for MIMD computers
[NASA-TM-101167] N90-29939
FLUID FLOW
Laser velocimetry N90-29317
FLUID JETS
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE90-015220] N90-29465
FLUID MECHANICS
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
Effect of particulate fillers on the rheology of polymer melts
[AD-A223601] N90-29512
Solid particle erosion in turbulent flows past tube banks
[DE90-015711] N90-29596
FLUID PRESSURE
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619
FLUORESCENCE
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
FLUOROCARBONS
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
FLUOROPOLYMERS
The optimum polymer binder for pressable high performance explosives: A preliminary evaluation
[ETN-90-97612] N90-29524
FLUTTER
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402
FLUTTER ANALYSIS
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
FLUX (RATE)
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
FLUX DENSITY
Brorfelde Geomagnetic Observatory: Magnetic results, 1987
[ISBN-87-7478-297-5] N90-29756
FLY BY WIRE CONTROL
Procedure for calibrating fly-by-wire control chains of the flying testbed ATTAS
[DLR-MITT-90-02] N90-29401
FOCI
A method of determining a laser-velocimeter focal point and measuring its beam properties using a hot-wire anemometer
[NAL-TR-1043] N90-29626
FOCUSING
XMM space telescope: Development plan for the lightweight replicated x ray gratings
[DE90-015620] N90-30055
FOOD PROCESSING
Factors affecting practical application of food irradiation
[DE90-631277] N90-29914
FORCE DISTRIBUTION
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
FORECASTING
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing
[AD-A224510] N90-29543
FORESTS
Effects of increased CO2 on forest response
[DE90-015406] N90-29708
FORMALISM
Temporal logics meet telerobotics N90-29905
FORMING TECHNIQUES
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming
[LR-621] N90-29451
FORMULATIONS
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
FOSSIL FUELS
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
FOURIER ANALYSIS
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587
FOURIER TRANSFORMATION
Image compression
[AD-A224242] N90-29998
Adaptive, robust, high-resolution signal processing
[AD-A223728] N90-30004
FRACTOGRAPHY
Fractographic analysis of fatigue crack growth under two-blocks loading on 2024-T351 sheet specimens
[LR-628] N90-29680
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
Fractographic observations on fatigue crack growth under miniTWIST flight-simulation loading (2024-T3 material)
[LR-631] N90-29684
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap
[NAL-TR-1047] N90-29686
FRACTURE MECHANICS
Assessment and improvement of aeroengine disc structural integrity N90-29392
Powder processing of aluminides
[DE90-015314] N90-29447
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
The ACR-program for automatic finite element model generation for part through cracks
[DE90-631545] N90-29662
Studies on crack mechanics
[AD-A223634] N90-29670
An investigation of crack-tip stress field criteria for predicting cleavage-crack initiation
[DE90-015597] N90-29672
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679
FRACTURE STRENGTH
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F
[PB90-207796] N90-29471
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
FRACTURING
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F
[PB90-207796] N90-29471
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Some aspects of the structure and evolution of oceanic spreading centers N90-29757
FRAGMENTS
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
FRAMES (DATA PROCESSING)
Direct estimation of structure and motion from multiple frames
[AD-A223903] N90-29985
FREE ELECTRON LASERS
Development of an all solid state 6 kHz pulse generator for driving free electron laser amplifiers
[AD-A224105] N90-29561
High average power CW FELS (Free Electron Laser) for application to plasma heating: Designs and experiments
[DE90-011085] N90-29633
FREE FLOW
Calibration of the PARC program for propulsion-type flows
[AD-A224253] N90-29395
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596

FREQUENCY ASSIGNMENT
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing
[AD-A224510] N90-29543
FREQUENCY CONVERTERS
Laser physics and laser spectroscopy
[AD-A224379] N90-29628
FREQUENCY DISTRIBUTION
Jamming performance of frequency-hopped communication systems with nonuniform hopping distributions
[AD-A223419] N90-29547
FREQUENCY HOPPING
Jamming performance of frequency-hopped communication systems with nonuniform hopping distributions
[AD-A223419] N90-29547
FREQUENCY SHIFT
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed
[AD-A223446] N90-29549
FRICTION
Reliability and performance of friction measuring tires and friction equipment correlation
[AD-A223694] N90-29408
The friction and wear of lubricated Si3N4/SiC(w) composites
[DE90-015790] N90-29448
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
FRICTION MEASUREMENT
Reliability and performance of friction measuring tires and friction equipment correlation
[AD-A223694] N90-29408
FRONTS (METEOROLOGY)
Detection and analysis of wind fronts and current shear in digital SAR images
[FFI-89/7016] N90-29755
FUEL CELLS
Electrochemical characteristics of acid electrolytes for fuel cells
[PB90-244385] N90-29693
Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes
[DE90-016626] N90-29699
FUEL COMBUSTION
Combustion characteristics of oxygen/hydrogen high pressure preburners for staged combustion cycle rocket engine
[NAL-TR-1044] N90-29434
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
FUEL CONSUMPTION
Airline productivity relating on the fuel cost. (2): Fuel consumption values and fuel efficiency
[NAL-TM-604-2] N90-29333
FUEL FLOW
Analysis of scramjet engine characteristics
[NAL-TR-1041] N90-29398
FUEL INJECTION
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397
Combustion characteristics of oxygen/hydrogen high pressure preburners for staged combustion cycle rocket engine
[NAL-TR-1044] N90-29434
FUEL SPRAYS
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
FUNCTIONAL ANALYSIS
An error estimate for Tremolieres method for the discretization of parabolic variational inequalities
[DE90-627169] N90-30024
FUNCTIONS (MATHEMATICS)
Local interpolation functions for curve generation with the multi-surface transformation N90-29608
FUSES (ORDNANCE)
Investigation method for AA-proximity fuses
[FEL-89-A194] N90-29535
FUSION (MELTING)
Aircraft battle damage repair of transparencies
[AD-A224168] N90-29387
FUSION REACTORS
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system
[DE90-015203] N90-29620
Accurate calculations of neutron kerma and damage from ENDF/B-VI evaluations for silicon, chromium, iron and nickel, and comparison with ENDF/B-V results
[DE90-016020] N90-29674
A distributed control and monitor system used in laser fusion research
[DE90-011483] N90-30078
Overview of advanced fuel fusion
[DE90-015660] N90-30085

G

GADOLINIUM ISOTOPES
Examinations of hyperfine structure and isotope displacement of the elements gadolinium and europium with laser fluorescence and two photon spectroscopy
[ETN-90-97312] N90-29468
GALAXIES
An observational study of disk-population globular clusters N90-30145
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151
GALERKIN METHOD
Dual and primal mixed Petrov-Galerkin finite element methods in heat transfer problems
[DE90-627190] N90-29592
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
GALLIUM ARSENIDES
Innovative techniques for the production of low cost 2D laser diode arrays
[AD-A223575] N90-29632
Surface photovoltage spectroscopy of real n-type GaAs(110) surfaces
[DE90-627325] N90-30092
Nonlinear optical studies of the optical and electronic properties of semiconductor heterostructures
[AD-A223408] N90-30096
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
GAME THEORY
For the definition of two person zero sum games
[ETN-90-97294] N90-30022
GAMMA RAY SPECTROMETERS
New developments in low-energy cosmic gamma-ray detection
[UT-HE-90/07] N90-30165
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166
GAMMA RAYS
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164
New developments in low-energy cosmic gamma-ray detection
[UT-HE-90/07] N90-30165
GAS COMPOSITION
Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
GAS DISCHARGE TUBES
On the technology for preparation of a HeNe discharge tube for use in a laser gyro
[DLR-MITT-90-01] N90-29624
GAS DYNAMICS
Interferometry N90-29315
GAS EXCHANGE
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
GAS FLOW
Velocity interferometry N90-29316
Electron beam for velocity determination N90-29319
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
Counter-current flow limitation in thin rectangular channels
[DE90-015124] N90-29599
GAS LASERS
Planar waveguide spectrometer
[DE90-016308] N90-30057
GAS MIXTURES
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
GAS PRESSURE
Investigation of a heat driven thermoacoustic prime mover
[AD-A223928] N90-29694
GAS TURBINE ENGINES
Recommended practices for measurement of gas path pressures and temperatures for performance assessment of aircraft turbine engines and components
[AGARD-AR-245] N90-29393
GAS TURBINES
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
GAS WELDING
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
GAS-LIQUID INTERACTIONS
Relic gravitational waves and extended inflation
[NASA-CR-186469] N90-29740
GASES
Thermochemical data for silicon-containing species from ab initio electronic structure calculations
[DE90-011024] N90-29463
GAUGE THEORY
Effective actions for bosonic topological defects
[NASA-CR-187271] N90-30041
GAUSS EQUATION
Gaussons and states with gaussian Wigner functions are quasi-free states
[DE90-628370] N90-30121
GEARS
The effects of gear reduction on robot dynamics N90-29861
GELS
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765
GEOLOGICAL FAULTS
Some aspects of the structure and evolution of oceanic spreading centers N90-29757
GEOLOGICAL SURVEYS
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722
GEOMAGNETIC LATITUDE
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
GEOMAGNETISM
Atmospheric structure and variability
[AD-A223439] N90-29734
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
Brorfelde Geomagnetic Observatory: Magnetic results, 1987
[ISBN-87-7478-297-5] N90-29756
GEOMETRICAL OPTICS
Polarization correction of Luneburg lens with chiral medium
[PB90-189127] N90-30046
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
GEOMETRY
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
GEOPHYSICS
Geophysical turbulence research at NCAR
[AD-A223361] N90-29732
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
GERMANIUM
Kinetic pathway in Stranski-Krastanov growth of Ge on Si(001)
[AD-A224324] N90-29456

Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460

GIBBS FREE ENERGY
Mechanism of habit change for atmospheric ice crystal growth N90-29717

GIOTTO MISSION
ESA's report to the 28th COSPAR meeting
[ESA-SP-1124] N90-30141
Dust emission by Comet P/Halley 1982i N90-30159

GLACIERS
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691

GLASS
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507
Lapping: Polishing and shear mode grinding
[DE90-015188] N90-29533
A viscoelastic material model for computing stresses in glass
[DE90-014851] N90-29673
Two terminal CuInSe2 based cascade cells
[DE90-000363] N90-29697

GLASS COATINGS
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446

GLASS FIBERS
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446

GLOBAL POSITIONING SYSTEM
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
GPS integrity requirements for use by civil aviation N90-29339
Integration of GPS and strapdown inertial subsystems into a single unit N90-29340
Combining LORAN and GPS: The best of both worlds N90-29343
Techniques for autonomous GPS integrity monitoring N90-29345
Modular digital GPS receivers N90-29346
Integration of GPS/INS with partitioned filters N90-29347
The 2-D and 3-D characterizations of GPS navigation service N90-29348
Applications of differential GPS N90-29349
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350
The determination of PDOP (Position Dilution of Precision) in GPS N90-29351
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
A low cost inertial/GPS integrated approach to land navigation N90-29374
An integrated system for land navigation N90-29377

GLOBULAR CLUSTERS
An observational study of disk-population globular clusters N90-30145
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152

GOVERNMENTS
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137

GRAIN BOUNDARIES
Processability and high temperature behavior of emerging aerospace alloys
[AD-A224265] N90-29475
Alloy design of ordered intermetallics
[DE90-016031] N90-29490
Atomistic studies of grain boundaries in alloys and compounds
[DE90-012401] N90-29492

GRAIN SIZE
Microstructure of alpha-Al base matrix/SiC particulate composites
[DE90-014894] N90-29449
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520

GRAMMARS
Short encodings of evolving structures
[AD-A223641] N90-29944

GRAND UNIFIED THEORY
Microwave background distortions from domain walls
[NASA-CR-187272] N90-29556

GRAPH THEORY
Using minimal spanning trees to compare the reliability of network topologies
[NASA-TM-4208] N90-30014

GRAPHIC ARTS
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934

GRATINGS (SPECTRA)
Evaluation of a potential Wave Division Multiplexer (WDM) for use in the IRSTD
[AD-A223945] N90-29560
XMM space telescope: Development plan for the lightweight replicated x ray gratings
[DE90-015620] N90-30055
Planar waveguide spectrometer
[DE90-015308] N90-30057

GRAVITATION
A new vector-tensor theory and higher-dimensional cosmology
[DE90-507990] N90-30117

GRAVITATIONAL EFFECTS
Satellite motion in an axi-symmetric gravitational field. Part 1: Perturbations due to J2 (second order) and J3
[RAE-TR-88068] N90-29429

GRAVITATIONAL FIELDS
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735

GRAVITATIONAL WAVES
Relic gravitational waves and extended inflation
[NASA-CR-186469] N90-29740

GRAVITY GRADIOMETERS
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735

GRAVITY WAVES
Relic gravitational waves and extended inflation
[NASA-CR-186469] N90-29740
Tests of initialization procedures with the NRL limited area numerical weather prediction model
[AD-A223549] N90-29750

GRAZING FLOW
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber
[NAL-TM-603] N90-30030

GREENHOUSE EFFECT
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-208588] N90-29701
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704
Effects of increased CO2 on forest response
[DE90-015406] N90-29708
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710

GRID GENERATION (MATHEMATICS)
A package for 3-D unstructured grid generation, finite-element flow solution and flow field visualization
[NASA-CR-182090] N90-29309
Optimization of tetrahedrical meshes for finite element calculation methods in fluids mechanics
[ETN-90-97560] N90-29603
Numerical Grid Generation
[VKI-LS-1990-06] N90-29606
Grid generation N90-29607
Local interpolation functions for curve generation with the multi-surface transformation N90-29608
The control point form of algebraic grid generation N90-29609
The fundamentals of adaptive grid movement N90-29610
Unstructured mesh methods for CFD N90-29611
Elliptic grid generation N90-29612

GRINDING
Lapping: Polishing and shear mode grinding
[DE90-015188] N90-29533

GROUND STATE
Sigma and pi interactions of the pyrrolic ligand sandwich-like lanthanide phthalocyanines determined from magnetic susceptibility and ligand-field theory
[AD-A223609] N90-29444
Theoretical investigations of Pi-conjugated polyradicals as models for organic magnetic materials
[AD-A223411] N90-29461
On a calculation of the ground-state energy in quantum mechanics
[DE90-627182] N90-30119

GROUND STATIONS
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364

GROUND TESTS
Evaluation for DLC-Flap Monitoring System of the VSRA
[NAL-TM-607] N90-29391
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424
An intelligent, free-flying robot N90-29912

GROUP THEORY
Gaussons and states with gaussian Wigner functions are quasi-free states
[DE90-628370] N90-30121

GUN PROPELLANTS
Electrical ignition of HAN-based liquid propellants
[AD-A223272] N90-29528

GYROSCOPES
Kalman filter formulations for transfer alignment of strapdown inertial units N90-29342

H

HABITS
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770

HALL EFFECT
Workshop on Low-Dimensional Quantum Field Theory and its Applications
[DE90-508071] N90-30116

HAMILTONIAN FUNCTIONS
Adiabatic invariance and transient resonance in very slowly varying oscillatory Hamiltonian systems
[DE90-016118] N90-30007
A canonical integration technique of arbitrary order
[DE90-628377] N90-30025
Symmetry and island structure of the standard map
[DE90-508076] N90-30069
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093
On Dirac's conjecture for Hamiltonian systems with first and second class constraints
[DE90-627206] N90-30116

HARDNESS
Effects of low Chromium(3) concentration in electrodeposition of low contraction chromium
[AD-A223338] N90-29477
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505

HARDNESS TESTS
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499

HARMONIC OSCILLATORS
On a calculation of the ground-state energy in quantum mechanics
[DE90-627182] N90-30119

HARTREE APPROXIMATION
On hydrogen chemisorption on metals: The electron correlation effects
[DE90-627318] N90-29473
On equations of motion on complex Grassman manifold
[DE90-628369] N90-29999

HASTELLOY (TRADEMARK)
A welding metallurgy study of Hastelloy Alloys B-2 and W
[DE90-011910] N90-29481

HAZARDS
Techniques for developing a system safety risk assessment model
[AD-A223477] N90-29654
Preliminary hazard analysis in design application to EVA space suit
[ETN-90-97585] N90-29918

HEARING
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775

HEAT FLUX
The skin temperature of mountain slopes and the determination of the sensible heat flux
[DLR-FB-90-07] N90-29754

HEAT MEASUREMENT
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702
HEAT RESISTANT ALLOYS
Processability and high temperature behavior of emerging aerospace alloys [AD-A224285] N90-29475
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy [AD-A223676] N90-29480
HEAT SINKS
Reliability study of TWT output RF window [AD-A223688] N90-29574
HEAT TRANSFER
Studies of surface heat transfer in an arc-heated wind tunnel [NAL-TR-1048] N90-29410
A cost-effective realization of environmental temperature control [DE90-011651] N90-29532
Spectral measurements of the wall shear stress and wall pressure in a turbulent boundary layer: Theory [AD-A224070] N90-29586
Dual and primal mixed Petrov-Galerkin finite element methods in heat transfer problems [DE90-627190] N90-29592
Counter-current flow limitation in thin rectangular channels [DE90-015124] N90-29599
Finite difference modeling of laser diode ignited components [DE90-015652] N90-29635
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702
HEAT TRANSFER COEFFICIENTS
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction [AD-A224354] N90-29303
HEAT TRANSMISSION
Thermal transfers in unsteady compressible inviscid flow [ETN-90-97557] N90-29311
HEATING
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy [AD-A223673] N90-29479
A cost-effective realization of environmental temperature control [DE90-011651] N90-29532
HEAVY IONS
Optical emissions from bombarding atmospheric gases with heavy ions [AD-A223544] N90-30040
HELICOPTER WAKES
The Second ARO Workshop on Rotorcraft Interactional Aerodynamics [AD-A223310] N90-29304
HELICOPTERS
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989 [AD-A224256] N90-29299
HELIOSPHERE
Activities report of the Space Science Department [ESA-SP-1126] N90-30142
HELIPORTS
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989 [AD-A224256] N90-29299
HELIUM
Isotopic tailoring and other techniques used to study helium effects in austenitic alloys [DE90-016344] N90-29495
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments [DE90-016360] N90-29496
Investigation of a heat driven thermoacoustic prime mover [AD-A223928] N90-29694
HELIUM ISOTOPES
On the technology for preparation of a HeNe discharge tube for use in a laser gyro [DLR-MITT-90-01] N90-29624
Overview of advanced fuel fusion [DE90-015660] N90-30085
HELIUM PLASMA
Control of helium accumulation [DE90-015658] N90-30084
HELIUM-NEON LASERS
On the technology for preparation of a HeNe discharge tube for use in a laser gyro [DLR-MITT-90-01] N90-29624
HELMET MOUNTED DISPLAYS
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29828
Visual processing: Implications for helmet mounted displays [AD-A223488] N90-29916
HEMODYNAMIC RESPONSES
Renal response to seven days of lower body positive pressure in the squirrel monkey [NASA-CR-183355] N90-29761
HERMETIC SEALS
Development and evaluation of hermetic laser diode ignited pyrotechnic components [DE90-015745] N90-29529
A viscoelastic material model for computing stresses in glass [DE90-014851] N90-29673
HETEROGENEITY
Regional phase propagation in three dimensionally heterogeneous media [AD-A223279] N90-29731
HETEROJUNCTIONS
Nonlinear optical studies of the optical and electronic properties of semiconductor heterostructures [AD-A223408] N90-30096
HEURISTIC METHODS
Automatic recognition of tractability in inference relations [AD-A223698] N90-30003
HIERARCHIES
Design of a structural and functional hierarchy for planning and control of telerobotic systems N90-29820
An algebraic hierarchical basis preconditioner [DE90-015875] N90-30008
HIGH ALTITUDE BALLOONS
High altitude balloon flight test of the GRAD experiment [AD-A224398] N90-29388
HIGH FREQUENCIES
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing [AD-A224510] N90-29543
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed [AD-A223446] N90-29549
High frequency bundle protection [DIGEL-1990-1] N90-29582
HIGH POWER LASERS
Innovative techniques for the production of low cost 2D laser diode arrays [AD-A223575] N90-29632
Proceedings of the High Energy Density Materials Contractors Conference [AD-A223793] N90-29695
HIGH PRESSURE
Combustion characteristics of oxygen/hydrogen high pressure preburners for staged combustion cycle rocket engine [NAL-TR-1044] N90-29434
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
HIGH RESOLUTION
High range resolution radar cross-section profiles: A preliminary analysis [AD-A223448] N90-29550
Adaptive, robust, high-resolution signal processing [AD-A223728] N90-30004
HIGH SPEED PHOTOGRAPHY
Analysis of pyrotechnic devices by laser-illuminated high speed photography [DE90-015741] N90-29530
HIGH TEMPERATURE
Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design [DE90-016039] N90-29491
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions [BR114894] N90-29646
Two terminal CuInSe2 based cascade cells [DE90-000363] N90-29697
Advanced materials and electrochemical processes in high-temperature solid electrolytes [DE90-015552] N90-30104
HIGH TEMPERATURE ENVIRONMENTS
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales [DE90-015710] N90-29488
HIGH TEMPERATURE SUPERCONDUCTORS
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088
Practical superconductor development for electrical power applications [DE90-014836] N90-30109
Superconductivity and information exchange [DE90-015767] N90-30110
Workshop on Low-Dimensional Quantum Field Theory and its Applications [DE90-508071] N90-30118
HIGH VOLTAGES
High voltage picosecond pulse generation using avalanche diodes [DE90-015194] N90-29577
HILBERT SPACE
An error estimate for Tremolieres method for the discretization of parabolic variational inequalities [DE90-627169] N90-30024
Introductory lectures on conformal field theory and strings [DE90-627219] N90-30120
HIPPARCOS SATELLITE
ESA's report to the 28th COSPAR meeting [ESA-SP-1124] N90-30141
HISTORIES
Textual regularities applicable to full text searching: The case of family history literature N90-30125
HMX
The optimum polymer binder for pressable high performance explosives: A preliminary evaluation [ETN-90-97612] N90-29524
HOLOGRAPHY
Photoinduced and holographically reinforced light diffusion in electrooptic crystals [ETN-90-97321] N90-30060
HOMOMORPHISMS
Hyperbolic Hjelmslev groups [ETN-90-97298] N90-30009
HONEYCOMB CORES
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber [NAL-TM-603] N90-30030
HONEYCOMB STRUCTURES
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates [AD-A223451] N90-29442
HORIZONTAL BRANCH STARS
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152
HOT ELECTRONS
Subpicosecond Raman study of hot electrons and hot phonons in GaAs [DE90-015634] N90-30106
Extended characterization of the damage by hot charge carriers in gate oxide by short channel MOS field effect transistors [ETN-90-97313] N90-30114
HOT PRESSING
Powder processing of aluminides [DE90-015314] N90-29447
HOT-WIRE ANEMOMETERS
A method of determining a laser-velocimeter focal point and measuring its beam properties using a hot-wire anemometer [NAL-TR-1043] N90-29626
HOUSINGS
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap [NAL-TR-1047] N90-29686
HOVERING
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows [AD-A224238] N90-29302
HUMAN BODY
Microscopic models for electromagnetic wave propagation in highly dispersive media [AD-A224382] N90-29540
HUMAN FACTORS ENGINEERING
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
Response to reflected-force feedback to fingers in teleoperations N90-29837
A procedure concept for local reflex control of grasping N90-29839
The telerobot workstation testbed for the shuttle aft flight deck: A project plan for integrating human factors into system design N90-29887
Information processing and perceptual characteristics of display design: The role of emergent features and objects [AD-A223683] N90-30133

HUMAN PERFORMANCE
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770
Robotic tele-existence N90-29796
Human error classification and data collection
[DE90-631406] N90-29915
HYBRID CIRCUITS
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573
HYDRAULIC EQUIPMENT
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
HYDRAULIC FLUIDS
Compatibility of elastomeric seal compounds with MIL-H-6083 and MIL-H-46170 hydraulic fluid
[AD-A224248] N90-29504
HYDROBALLISTICS
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
HYDRODYNAMIC EQUATIONS
Unstable phenomena in mechanical systems
[AD-A223640] N90-30001
HYDRODYNAMICS
Innovative uses of parallel computers
[AD-A223578] N90-29980
Unstable phenomena in mechanical systems
[AD-A223640] N90-30001
HYDROGEN
On hydrogen chemisorption on metals: The electron correlation effects
[DE90-627318] N90-29473
Formation of hydrogen line and continuum emission in young stellar objects N90-30150
HYDROGEN ATOMS
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
On a calculation of the ground-state energy in quantum mechanics
[DE90-627182] N90-30119
HYDROGEN BONDS
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459
Mechanism of habit change for atmospheric ice crystal growth N90-29717
HYDROGEN ENGINES
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397
HYDROGEN IONS
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29895
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
HYDROGEN OXYGEN ENGINES
Investigation of fluid dynamic performance of LE-7 liquid oxygen pump
[NAL-TR-1020] N90-29650
HYDROGEN PLASMA
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
HYDROLYSIS
Kinetics and structure of silicate sol-gels
[DE90-015702] N90-29521
HYDROMECHANICS
Modeling towed cable system dynamics
[AD-A223610] N90-29644
HYDROPHONES
Piezoelectric and electrostrictive materials for transducer applications, volume 1
[AD-A223560] N90-29668
HYDROSTATICS
Integrated controls and health monitoring fiberoptic shaft monitor
[NASA-CR-185210] N90-29622
HYDROXYL RADICALS
Spectroscopy of propellant-related flames
[AD-A224068] N90-29525
HYPERBOLIC FUNCTIONS
Hyperbolic Hjelmslev groups
[ETN-90-97298] N90-30009
HYPERCUBE MULTIPROCESSORS
Parallelization of a method for solving three dimensional Navier-Stokes equations on a distributed memory multiprocessor
[ONERA-RTS-1/3717-CY] N90-29983
HYPERFINE STRUCTURE
Examinations of hyperfine structure and isotope displacement of the elements gadolinium and europium with laser fluorescence and two photon spectroscopy
[ETN-90-97312] N90-29488
HYPERSONIC FLIGHT
Optimal trajectories for hypervelocity flight N90-29378
HYPERSONIC FLOW
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
Feasibility of the temperature measurements in hypersonic flow by multibeam coherent Raman anti-Stokes scattering
[ONERA-RF-56/7131-PY] N90-29312
Measurement Techniques for Hypersonic Flows
[VKI-LS-1990-05] N90-29314
Electron-beam fluorescence measurements in hypersonic flows N90-29318
Applications of LIF to high speed flows N90-29320
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE)
[NAL-TR-1028] N90-29330
A numerical calculation of hypersonic flow around blunt bodies using upwind difference scheme
[NAL-TR-1025] N90-29331
HYPERSONIC WIND TUNNELS
Infrared thermography N90-29325
HYPERVELOCITY WIND TUNNELS
Applications of LIF to high speed flows N90-29320
HYPOTHESES
Approximate equations for heat conduction in multi-layered cylindrical shells
[NAL-TR-1049] N90-29614
HYPOXIA
Oxygen deficiency monitor system
[DE90-014866] N90-29917
HYSTERESIS
Nonlinear modeling of joint dominated structures
[NASA-CR-4324] N90-29423

I

ICE FORMATION
The signals of an ice warning device in dependence on total water content and normalized icing degree
[ESA-TT-1207] N90-29692
Mechanism of habit change for atmospheric ice crystal growth N90-29717
A documentation of icing-relevant cloud physical parameters on vertical soundings of stratiform clouds
[DLR-MITT-90-07] N90-29753
IDENTIFYING
Nondestructive material characterization
[DE90-015176] N90-29652
Submicron particle analyzer
[AD-A223558] N90-30050
Tokamak plasma shape identification with a Legendre-Fourier expansion of the vacuum poloidal flux function in the toroidal coordinates
[DE90-508031] N90-30068
IGNITERS
Electrical ignition of HAN-based liquid propellants
[AD-A223272] N90-29528
IGNITION
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
Electrical ignition of HAN-based liquid propellants
[AD-A223272] N90-29528
Development and evaluation of hermetic laser diode ignited pyrotechnic components
[DE90-015745] N90-29529
IGNITION TEMPERATURE
Finite difference modeling of laser diode ignited components
[DE90-015652] N90-29635
IMAGE ANALYSIS
A global approach to image texture analysis
[AD-A223532] N90-29941
A manual for microcomputer image analysis
[DE90-015629] N90-29958
Determination of density using simultaneous interferometry methods
[IMFL-90/04] N90-30061
IMAGE CORRELATORS
A compact real-time acousto-optic image correlator
[DE90-015584] N90-30054
IMAGE FILTERS
A reduced-order extended Kalman filter for moving images
[AD-A223742] N90-30028
IMAGE PROCESSING
A land navigation demonstration vehicle with a color map display for tactical use N90-29375
Electro-optics engineering support for the integrated launch and recovery television surveillance system
[AD-A223450] N90-29406
AutoPAVER: A software package for automated pavement evaluation
[AD-A224176] N90-29531
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies
[AD-A224358] N90-29539
Long-term flat-field behavior in LLNL streak cameras: Preliminary results
[DE90-015615] N90-29621
Detection and analysis of wind fronts and current shear in digital SAR images
[FFI-89/7016] N90-29755
The 3D model control of image processing N90-29800
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
Trinocular stereovision using figural continuity, dealing with curved objects N90-29802
A fast 3-D object recognition algorithm for the vision system of a special-purpose dexterous manipulator N90-29803
Visual processing: Implications for helmet mounted displays
[AD-A223488] N90-29916
Digital color representation
[DE90-014580] N90-29924
Parallel architectures and algorithms for image understanding
[AD-A223479] N90-29940
A global approach to image texture analysis
[AD-A223532] N90-29941
A comparison of hardware implementations for low-level vision algorithms
[AD-A223699] N90-29945
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
A manual for microcomputer image analysis
[DE90-015629] N90-29958
Handbook of data compression algorithms
[ESA-TM-06] N90-29969
Direct estimation of structure and motion from multiple frames
[AD-A223903] N90-29985
Image compression
[AD-A224242] N90-29998
A compact real-time acousto-optic image correlator
[DE90-015564] N90-30054
IMAGE RECONSTRUCTION
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies
[AD-A224358] N90-29539
IMAGERY
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224580] N90-29775
IMAGES
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224580] N90-29775
Ray traced scalar fields with shaded polygonal output
[DE90-011023] N90-29955
IMAGING SPECTROMETERS
Characteristics of pushbroom scanning type radiometer utilizing linear sensors
[NAL-TR-1024] N90-29625
IMAGING TECHNIQUES
Laser induced fluorescence imaging applications N90-29322
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
IMPACT
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443
IMPACT DAMAGE
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates
[AD-A223451] N90-29442

IMPACT TESTS
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
IMPEDANCE
Impedance hand controllers for increasing efficiency in teleoperations N90-29793
IMPEDANCE MATCHING
Research into traveling wave control in flexible structures
[AD-A224504] N90-29661
IMPEDANCE MEASUREMENT
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619
IMPURITIES
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494
IN-FLIGHT MONITORING
Evaluation for DLC-Flap Monitoring System of the VSRA
[NAL-TM-607] N90-29391
INCIDENCE
High power oblique incidence HF ionospheric modification
[AD-A224402] N90-29729
INCOHERENCE
An x ray source for lithography
[AD-D014596] N90-29630
INCOMPRESSIBLE FLOW
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
INDENTATION
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
INDEXES (DOCUMENTATION)
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989
[AD-A224256] N90-29299
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
INDONESIA
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691
INDUCTANCE
Application of a rechargeable, small caliber railgun power supply
[AD-A224207] N90-29418
INDUCTION HEATING
Aircraft battle damage repair of transparencies
[AD-A224168] N90-29387
INDUSTRIES
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
INERTIAL CONFINEMENT FUSION
A review of self generated B-field in ICF corona
[DE90-627479] N90-30063
UCD-LLNL collaboration on basic plasma physics research in inertial confinement fusion
[DE90-015771] N90-30081
INERTIAL GUIDANCE
Ring laser gyro principles and techniques N90-29352
INERTIAL NAVIGATION
Integration of GPS/INS with partitioned filters N90-29347
Inertial grade fiber gyros N90-29353
Use of a three-axis monolithic ring laser gyro and digital signal processor in an inertial sensor element N90-29354
Ring laser gyro marine inertial navigation systems N90-29355
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
Integrated navigation/flight control for future high performance aircraft N90-29362
State estimation for systems moving through random fields N90-29373
A low cost inertial/GPS integrated approach to land navigation N90-29374
A land navigation demonstration vehicle with a color map display for tactical use N90-29375
An integrated system for land navigation N90-29377
Inertial navigation system simulator program: Top-level design
[AD-A223762] N90-29379
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735
INERTIAL REFERENCE SYSTEMS
Application of multifunction inertial reference systems to fighter aircraft N90-29341
INFERENCE
Systems reliability and inference: Summary of accomplishments 1988-1990
[AD-A224433] N90-29653
What kind of computation is intelligence. A framework for integrating different kinds of expertise N90-29817
Strategies for tutoring multiple bugs
[AD-A223921] N90-29927
An analysis of the distinction between deep and shallow expert systems
[AD-A224443] N90-29987
Saddlepoint approximations in conditional inference
[AD-A223280] N90-30000
Automatic recognition of tractability in inference relations
[AD-A223698] N90-30003
INFORMATION DISSEMINATION
Overview of Omega signal coverage N90-29368
External information sources and aerospace R/D: The use and importance of technical reports by US Aerospace engineers and scientists
[NASA-TM-101232] N90-30132
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137
INFORMATION MANAGEMENT
Information management in an integrated space telerobot N90-29846
INFORMATION PROCESSING (BIOLOGY)
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic
[AD-A223611] N90-29552
A layered abduction model of perception: Integrating bottom-up and top-down processing in a multi-sense agent N90-29851
INFORMATION RETRIEVAL
Textual regularities applicable to full text searching: The case of family history literature N90-30125
Search strategies for computer-stored information: A microcomputer tutorial N90-30126
INFORMATION SYSTEMS
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations
[NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition
[NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
Results from Alouette 1, Explorer 20, Alouette 2, and Explorer 31
[NASA-TM-101822] N90-29690
The worldwide ionospheric data base
[NASA-TM-101823] N90-29714
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations
[NASA-TM-101880] N90-30123
External information sources and aerospace R/D: The use and importance of technical reports by US Aerospace engineers and scientists
[NASA-TM-101232] N90-30132
Integration of information systems components
[DE90-011761] N90-30136
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations
[NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations
[NASA-TM-89695] N90-30148
Interplanetary medium data book, supplement 4, 1985-1988
[NASA-TM-101867] N90-30149
A guide to the National Space Science Data Center
[NASA-TM-89637] N90-30167
INFORMATION THEORY
The effect of software reusability on information theory based software metrics
[AD-A224472] N90-29936
INFORMATION TRANSFER
Multisensor evaluation framework
[AD-A224271] N90-29913
INFRARED DETECTORS
Quantum well infrared detectors 1: Some calculations of their optical properties
[RSRE-MEMO-4363] N90-30062
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100
INFRARED IMAGERY
Thermal imaging assessment
[AD-A224400] N90-29542
INFRARED INTERFEROMETERS
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
INFRARED RADIATION
Pointing control system for the Teal Ruby experiment N90-29370
Theoretical and experimental comparison of infrared and visible laser scattering from a variety of surface types
[RSRE-MEMO-4348] N90-29636
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29728
INFRARED RADIOMETERS
Infrared thermography N90-29325
INFRARED SPECTRA
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29728
INFRARED SPECTROSCOPY
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30148
INSERTION LOSS
Evaluation of a thermistior power measurement system for use on the NPL antenna extrapolation range
[NPL-DES-89] N90-29583
INSPECTION
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates
[AD-A223451] N90-29442
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap
[NAL-TR-1047] N90-29686
INTEGRALS
Trapezoidal stratified Monte Carlo integration
[AD-A223565] N90-30021
INTEGRATED CIRCUITS
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573
A single wafer bit-sliced convolver: An optimum statistical solution for the implementation of redundancy
[REPT-89-019] N90-29584
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953
INTEGRATED OPTICS
Planar waveguide spectrometer
[DE90-016308] N90-30057
INTEGRITY
GPS integrity requirements for use by civil aviation N90-29339
Analysis of the integrity of the Microwave Landing System (MLS) data functions N90-29365
INTELLIGENCE
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794

INTERACTIONAL AERODYNAMICS
The Second ARO Workshop on Rotorcraft Interactional Aerodynamics
[AD-A223310] N90-29304
INTERFACE STABILITY
Two terminal CuInSe2 based cascade cells
[DE90-000363] N90-29697
INTERFACES
Elastic interfaces
[REPT-90-003] N90-29742
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
INTERFEROMETERS
Determination of density using simultaneous interferometry methods
[IMFL-90/04] N90-30061
INTERFEROMETRY
Velocity interferometry N90-29316
Determination of density using simultaneous interferometry methods
[IMFL-90/04] N90-30061
INTERMETALLICS
Powder processing of aluminides
[DE90-015314] N90-29447
Alloy design of ordered intermetallics
[DE90-016031] N90-29490
Atomistic studies of grain boundaries in alloys and compounds
[DE90-012401] N90-29492
Fundamental studies on intermetallic compounds
[ONERA-RT-4/1855-M] N90-29497
INTERNATIONAL COOPERATION
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
INTERPLANETARY MAGNETIC FIELDS
Interplanetary medium data book, supplement 4, 1985-1988
[NASA-TM-101867] N90-30149
INTERPLANETARY MEDIUM
Interplanetary medium data book, supplement 4, 1985-1988
[NASA-TM-101867] N90-30149
INTERPLANETARY SPACE
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations
[NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition
[NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations
[NASA-TM-101880] N90-30123
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations
[NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations
[NASA-TM-89695] N90-30148
INTERPLANETARY SPACECRAFT
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations
[NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition
[NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations
[NASA-TM-101880] N90-30123
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations
[NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations
[NASA-TM-89695] N90-30148
INTERPOLATION
Local interpolation functions for curve generation with the multi-surface transformation N90-29608
Estimation and representation of multidimensional mappings
[DLR-MITT-90-06] N90-29967
Sensitivity of the error in multivariate statistical interpolation to parameter values
[AD-A224076] N90-30015
INTERPROCESSOR COMMUNICATION
On the stability of robotic systems with random communication rates N90-29865
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977
INTERSTELLAR EXTINCTION
An observational study of disk-population globular clusters N90-30145
INTERSTELLAR MAGNETIC FIELDS
Interstellar magnetic fields: An observational perspective N90-30144
INTERSTITIALS
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093
INTERVALS
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
INVARIANCE
Adiabatic invariance and transient resonance in very slowly varying oscillatory Hamiltonian systems
[DE90-016118] N90-30007
Spatial structure of particle-orbit loss regions in l=2 helical systems
[DE90-508080] N90-30073
INVERSIONS
Hitting lines with two-dimensional Brownian motion
[AD-A223595] N90-30027
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
INVISCID FLOW
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
ION BEAMS
Electron beam for velocity determination N90-29319
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
Prospects for nuclear astrophysics with intense radioactive ion beams
[DE90-015616] N90-30044
ION DENSITY (CONCENTRATION)
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730
ION DISTRIBUTION
Studies of ionospheric dynamics utilizing data from DMSP
[AD-A223370] N90-29733
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
ION EXTRACTION
Pulsed field sample neutralization
[DE90-015131] N90-29452
ION IMPLANTATION
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
ION IRRADIATION
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
IONIZATION
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
IONIZATION CHAMBERS
A tandem system of ionization chambers for effective energy determination of unknown X-radiation fields
[DE90-630463] N90-29405
IONIZING RADIATION
Activities of the Division of Microwave Technology
[FOA-C-30555-3.2] N90-29537
IONOSONDES
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
IONOSPHERIC DISTURBANCES
Ionospheric irregularities: Source, structure, plasma processes and effects on sensor systems
[AD-A223908] N90-29723
IONOSPHERIC DRIFT
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
IONOSPHERIC ION DENSITY
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A224392] N90-29725
IONOSPHERIC PROPAGATION
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A224392] N90-29725
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730
IONOSPHERIC SOUNDING
The worldwide ionospheric data base
[NASA-TM-101823] N90-29714
IRON
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
IRON ALLOYS
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
Isotopic tailoring and other techniques used to study helium effects in austenitic alloys
[DE90-016344] N90-29495
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
IRRADIATION
Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
Factors affecting practical application of food irradiation
[DE90-631277] N90-29914
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108

ISOTOPES
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151
ITERATION
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
Fast algorithms for parallel architectures [AD-A223731] N90-29947
Image compression [AD-A224242] N90-29998
ITERATIVE SOLUTION
Solution of nonlinear eigenvalue problems via parallel shooting [LR-587] N90-30013
IUE
ESA's report to the 28th COSPAR meeting [ESA-SP-1124] N90-30141
The impact of IUE on studies of the nova outburst: 1986-1990 [DE90-014915] N90-30156
IUE-ULDA access guide no. 2. International Ultraviolet Explorer-Uniform Low Dispersion Archive: Comets [ESA-SP-1134] N90-30157

J

J INTEGRAL
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F [PB90-207796] N90-29471
JAMMING
Modular digital GPS receivers N90-29346
PLRS: A new spread spectrum position location reporting system N90-29358
Jamming performance of frequency-hopped communication systems with nonuniform hopping distributions [AD-A223419] N90-29547
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation [AD-A223445] N90-29548
JAPAN
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE) [NAL-TR-1028] N90-29330
Some topics in computational transonic aerodynamics: Revision [NAL-TR-1018T] N90-29332
JET ENGINE FUELS
Production of jet fuels from coal-derived liquids. Volume 13: Evaluation of storage and thermal stability of jet fuels derived from coal liquids [AD-A224576] N90-29527
JET FLOW
Applications of LIF to high speed flows N90-29320
Calibration of the PARC program for propulsion-type flows [AD-A224253] N90-29395
JET STREAMS (METEOROLOGY)
An observational study of the circulation in the Southern Hemisphere stratosphere N90-29715
JFET
Polycrystalline diamond Junction Field Effect Transistors (JFETS) [AD-A223784] N90-29576
JOINTS (JUNCTIONS)
Nonlinear modeling of joint dominated structures [NASA-CR-4324] N90-29423
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
Traction-drive force transmission for telerobotic joints N90-29790
JOURNAL BEARINGS
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
JUDGMENTS
Information processing and perceptual characteristics of display design: The role of emergent features and objects [AD-A223683] N90-30133

K

K-EPSILON TURBULENCE MODEL
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
KALMAN FILTERS
Kalman filter formulations for transfer alignment of strapdown inertial units N90-29342
Integration of GPS/INS with partitioned filters N90-29347
Observability of relative navigation using range-only measurements N90-29360
State estimation for systems moving through random fields N90-29373
Direct estimation of structure and motion from multiple frames [AD-A223903] N90-29985
A reduced-order extended Kalman filter for moving images [AD-A223742] N90-30028
KINEMATIC EQUATIONS
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
Design and control of a multi-fingered robot hand provided with tactile feedback N90-29789
KINEMATICS
A method for modeling kinematic hardening and cyclic strain effects [ONERA-RT-77/1765-RY-089-R] N90-29677
Windshear estimation along the trajectory of an aircraft N90-29745
How to push a block along a wall N90-29848
Recursive multibody dynamics and discrete-time optimal control N90-29860
Kinematic sensitivity of robot manipulators N90-29863
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877
Inverse dynamics of a 3 degree of freedom spatial flexible manipulator N90-29878
A spatial operator algebra for manipulator modeling and control N90-29894
KINETIC ENERGY
A search for low energy cosmic ray antiprotons N90-30161
KINETICS
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales [DE90-015710] N90-29488
KLYSTRONS
High power microwaves for defense and accelerator applications [AD-A223550] N90-29572
KNOWLEDGE BASES (ARTIFICIAL INTELLIGENCE)
Reactive behavior, learning, and anticipation N90-29908
Knowledge base refinement as improving an incorrect and incomplete domain theory [AD-A224441] N90-29935
Knowledge-based expert system configurator [DE90-011711] N90-30135
KNOWLEDGE REPRESENTATION
Temporal logics meet telerobotics N90-29905
Knowledge base refinement as improving an incorrect and incomplete domain theory [AD-A224441] N90-29935
Machine recognition as representation and search [AD-A223700] N90-29946
An analysis of the distinction between deep and shallow expert systems [AD-A224443] N90-29987

L

LABORATORIES
The MTL Torsional Split-Hopkinson bar [AD-A223278] N90-29663
Oxygen deficiency monitor system [DE90-014866] N90-29917
LAMINAR BOUNDARY LAYER
Transition of the boundary layer [DERAT-RSF-50/5018-37] N90-29600
LAMINAR FLOW
Thermal transfers in unsteady compressible inviscid flow [ETN-90-97557] N90-29311
A boundary-layer transition model for the Navier-Stokes computation for a natural-laminar-flow airfoil [NAL-TR-1038T] N90-29328
Effects of 1 Hz imposed bulk flow unsteadiness on laminar/turbulent transition in a straight channel [AD-A223396] N90-29594
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling [LR-625] N90-29772
LAMINAR MIXING
Chemical kinetic and aerodynamic structures of flames [AD-A224281] N90-29455
LAMINATES
Aircraft battle damage repair of transparencies [AD-A224168] N90-29387
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates [AD-A223451] N90-29442
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite [AD-A223696] N90-29445
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming [LR-621] N90-29451
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
LANDAU-GINZBURG EQUATIONS
Propagation of chaos and the McKean-Vlasov equation in duals of nuclear spaces [AD-A224431] N90-30039
LANDSAT SATELLITES
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand [PB90-230095] N90-29691
LANGUAGE PROGRAMMING
Language and system support for concurrent programming [AD-A223760] N90-29949
LANTHANUM COMPOUNDS
Sigma and pi interactions of the pyrrolic ligand sandwich-like lanthanide phthalocyanines determined from magnetic susceptibility and ligand-field theory [AD-A223609] N90-29444
LAPLACE TRANSFORMATION
Classical and Bayes-P subset selection procedures for double exponential populations [AD-A223830] N90-30006
LARGE SPACE STRUCTURES
Suspension systems for ground testing large space structures [NASA-CR-4325] N90-29424
LASER APPLICATIONS
Investigation of laser diagnostics of PACVO (Plasma Assisted Chemical Vapor Deposition) processes for depositing hard face coatings [DE90-016209] N90-29522
Proceedings of the 14th Annual Electronics Manufacturing Seminar [AD-A224276] N90-29563
LASER BEAMS
Control and estimation for aerospace applications with system time delays N90-29367
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system [DE90-015203] N90-29620
A method of determining a laser-velocimeter focal point and measuring its beam properties using a hot-wire anemometer [NAL-TR-1043] N90-29626
Laser beam stop [AD-D014595] N90-29629
Soft x ray emission spectra from laser-irradiated high-Z targets [AD-A223552] N90-30099
Subpicosecond Raman study of hot electrons and hot phonons in GaAs [DE90-015634] N90-30106
LASER DOPPLER VELOCIMETERS
Laser velocimetry N90-29317
A method of determining a laser-velocimeter focal point and measuring its beam properties using a hot-wire anemometer [NAL-TR-1043] N90-29626
LASER FUSION
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system [DE90-015203] N90-29620
A distributed control and monitor system used in laser fusion research [DE90-011483] N90-30078
LASER GYROSCOPES
Ring laser gyro principles and techniques N90-29352
Use of a three-axis monolithic ring laser gyro and digital signal processor in an inertial sensor element N90-29354
Ring laser gyro marine inertial navigation systems N90-29355
Novel approaches to sensitivity enhancement of ring laser gyros [AD-A224335] N90-29617

On the technology for preparation of a HeNe discharge tube for use in a laser gyro
[DLR-MITT-90-01] N90-29624
LASER HEATING
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064
LASER INDUCED FLUORESCENCE
Electron-beam fluorescence measurements in hypersonic flows N90-29318
Applications of LIF to high speed flows N90-29320
Laser induced fluorescence imaging applications N90-29322
Laser induced fluorescence: Practical applications N90-29323
Laser beam stop
[AD-D014595] N90-29629
Pyrromethene-BF2 complexes as laser dyes
[AD-A223562] N90-29631
LASER MATERIALS
Laser physics and laser spectroscopy
[AD-A224379] N90-29628
LASER PLASMA INTERACTIONS
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
Experimental observations of nonlinear effects in laser-plasma interactions
[DE90-015195] N90-30079
LASER PLASMAS
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064
Experimental observations of nonlinear effects in laser-plasma interactions
[DE90-015195] N90-30079
UCD-LLNL collaboration on basic plasma physics research in inertial confinement fusion
[DE90-015771] N90-30081
Soft x ray contact imaging of biological specimens using a laser-produced plasma as an x ray source
[DE90-016098] N90-30082
Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099
LASER SPECTROSCOPY
Proceedings of the 45th Ohio State University Symposium on Molecular Spectroscopy
[AD-A224349] N90-29457
Examinations of hyperfine structure and isotope displacement of the elements gadolinium and europium with laser fluorescence and two photon spectroscopy
[ETN-90-97312] N90-29468
Laser physics and laser spectroscopy
[AD-A224379] N90-29628
Pyrromethene-BF2 complexes as laser dyes
[AD-A223562] N90-29631
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695
LASER TARGETS
Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099
LASERS
Model calculations for a 600 angstrom laser based on photopumping of Mo(sup 6+) by a spectral line of Mo(sup 11+)
[DE90-015202] N90-29634
LAUNCH VEHICLES
Investigation of fluid dynamic performance of LE-7 liquid oxygen pump
[NAL-TR-1020] N90-29650
LAUNCHING
Electro-optics engineering support for the integrated launch and recovery television surveillance system
[AD-A223450] N90-29406
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651
LEAD COMPOUNDS
Piezoelectric and electrostrictive materials for transducer applications, volume 1
[AD-A223560] N90-29668
LEAD ZIRCONATE TITANATES
Special purpose spatial light modulators
[AD-A223794] N90-30052
LEAKAGE
Leak detection aid
[DE90-014678] N90-29616
LEARNING
Integrating rule-based and neural-net techniques for spectral analysis
[AD-A223517] N90-29462
LEARNING THEORY
Learning in tele-autonomous systems using Soar N90-29819
Knowledge base refinement as improving an incorrect and incomplete domain theory
[AD-A224441] N90-29935
Search strategies for computer-stored information: A microcomputer tutorial N90-30126
LEAST SQUARES METHOD
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679
A parallel least squares collocation conjugate gradient approach for the advection diffusion equation
[DE90-015965] N90-29961
Analytic least squares
[NPL-DES-86] N90-29971
LENS ANTENNAS
Polarization correction of Luneburg lens with chiral medium
[PB90-189127] N90-30046
LIE GROUPS
Trees, bialgebras and intrinsic numerical algorithms
[NASA-CR-187031] N90-29925
LIFE SCIENCES
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-004] N90-29688
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-003] N90-29689
JPRS Report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-007] N90-29762
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-004] N90-29763
LIFE SUPPORT SYSTEMS
A lunar space station
[NASA-CR-186223] N90-30158
LIFT
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302
LIFTING ROTORS
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302
LIGANDS
Sigma and pi interactions of the pyrrolic ligand sandwich-like lanthanide phthalocyanines determined from magnetic susceptibility and ligand-field theory
[AD-A223609] N90-29444
LIGHT (VISIBLE RADIATION)
Theoretical and experimental comparison of infrared and visible laser scattering from a variety of surface types
[RSRE-MEMO-4348] N90-29636
Exogenous and endogenous control of activity behavior and the fitness of fish
[DLR-FB-90-14] N90-29766
LIGHT ADAPTATION
Exogenous and endogenous control of activity behavior and the fitness of fish
[DLR-FB-90-14] N90-29766
LIGHT AMPLIFIERS
Development of an all solid state 6 kHz pulse generator for driving free electron laser amplifiers
[AD-A224105] N90-29561
LIGHT EMISSION
Laser induced fluorescence imaging applications N90-29322
LIGHT IONS
Emission of quick neutrons and non-equilibrium phenomena by central shocks in the reaction 40 Ar + 40 Ca at 20 MeV/u
[ETN-90-97296] N90-30043
LIGHT MODULATION
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
Optical signal computing
[AD-A223624] N90-30051
Special purpose spatial light modulators
[AD-A223794] N90-30052
LIGHT SCATTERING
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
Submicron particle analyzer
[AD-A223558] N90-30050
Light scattering from surface and sub-surface defects
[DE90-016311] N90-30058
Photoinduced and holographically reinforced light diffusion in electrooptic crystals
[ETN-90-97321] N90-30060
LIGHT SOURCES
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
LIGHTNING
Numerical simulation of the lightning return stroke N90-29743
LIMITERS (FUSION REACTORS)
Overview of advanced fuel fusion
[DE90-015660] N90-30085
LINEAR ACCELERATORS
Long pulse diode experiments
[DE90-016218] N90-29578
Medium energy nuclear physics research
[DE90-015852] N90-30042
LINEAR ARRAYS
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
Characteristics of pushbroom scanning type radiometer utilizing linear sensors
[NAL-TR-1024] N90-29625
LINEAR ENERGY TRANSFER (LET)
An advanced single event upset tester
[AD-A223613] N90-30163
LINEAR OPERATORS
A spatial operator algebra for manipulator modeling and control N90-29894
LINEAR PROGRAMMING
Time optimal movement of cooperating robots N90-29815
New approaches to linear and nonlinear programming
[AD-A224328] N90-29932
LINEAR QUADRATIC GAUSSIAN CONTROL
Optimal control law phenomena in certain adaptive second-order observation systems
[AD-A224274] N90-29986
LINEAR SYSTEMS
Control and estimation for aerospace applications with system time delays N90-29367
Robust design of LQG controllers N90-29639
Modeling towed cable system dynamics
[AD-A223610] N90-29644
Systems reliability and inference: Summary of accomplishments 1988-1990
[AD-A224433] N90-29653
On the stability of robotic systems with random communication rates N90-29865
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
Some overdetermined systems of complex partial differential equations
[DE90-627162] N90-29995
LININGS
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber
[NAL-TM-603] N90-30030
LINKAGES
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
LIQUID CHROMATOGRAPHY
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE90-015220] N90-29465
LIQUID FILLED SHELLS
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
LIQUID FLOW
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
LIQUID OXYGEN
Investigation of fluid dynamic performance of LE-7 liquid oxygen pump
[NAL-TR-1020] N90-29650
LIQUID PHASE EPITAXY
Manufacturing and characterization of liquid-phase epitaxy layers with atomic levels at the crystal surface and at the hetero limit surfaces in the system GaAs-AlGaAs
[ETN-90-97310] N90-30113
LIQUIDS
Estimation of liquid heat capacities. 1: Review and evaluation of Missenard method
[AD-A224161] N90-29454
LITHIUM ALLOYS
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499

LITHIUM NIOBATES
Photoinduced and holographically reinforced light diffusion in electrooptic crystals
[ETN-90-97321] N90-30060
LITHOGRAPHY
An x ray source for lithography
[AD-D014596] N90-29630
LOADING MOMENTS
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934
LOADS (FORCES)
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
Estimation of power spectral density of runway roughness
[NAL-TR-1037] N90-29411
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683
Communications Interface Driver (CID) software principles of operation
[DOT/FAA/CT-TN89/46] N90-29937
LOCAL AREA NETWORKS
High speed bus technology development
[AD-A224486] N90-29565
Turbo pascal implementation of a distributed processing network of MS-DOS microcomputers connected in a master-slave configuration
[AD-A223925] N90-29928
Working implementation agreements for open systems interconnection protocols
[PB90-197948] N90-30127
LOCOMOTION
Exogenous and endogenous control of activity behavior and the fitness of fish
[DLR-FB-90-14] N90-29766
LOGIC
Temporal logics meet telerobotics N90-29905
An efficient temporal logic for robotic task planning N90-29906
LOGIC CIRCUITS
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
A VHDL interface for Altera design files
[AD-A224476] N90-29920
Optical signal computing
[AD-A223624] N90-30051
LOGICAL ELEMENTS
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
LOGISTICS
Airborne target detection, acquisition, and tracking devices
[AD-A223852] N90-29555
Performance monitoring, fault detection, fault localization design guidance
[AD-A223619] N90-29655
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
Software development: A product life-cycle perspective
[AD-A223783] N90-29952
LONG DURATION EXPOSURE FACILITY
Heavy Nucleus Collector (HNC) project for the NASA Long Duration Exposure Facility (LDEF)
[NASA-CR-182094] N90-30045
LONGITUDINAL CONTROL
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399
LORAN
Combining LORAN and GPS: The best of both worlds N90-29343
LOSS OF COOLANT
Thermal analyses of power subsystem components
[NASA-CR-186314] N90-29637
LOSSES
Spatial structure of particle-orbit loss regions in l=2 helical systems
[DE90-508080] N90-30073
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108
LOW CONCENTRATIONS
Effects of low Chromium(3) concentration in electrodepositon of low contraction chromium
[AD-A223338] N90-29477
LOW COST
A low cost inertial/GPS integrated approach to land navigation N90-29374
LOW DENSITY MATERIALS
Percolation and low density materials: Theory and applications
[AD-A224237] N90-29436
LOW TEMPERATURE
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29789
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088
LUBRICANTS
Scale effects in steady-state friction
[DE90-012943] N90-29647
LUBRICATION
The friction and wear of lubricated Si3N4/SiC(w) composites
[DE90-015790] N90-29448
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651
LUMINESCENCE
Electronic and photonic power applications
[DE90-015567] N90-29698
LUMINOUS INTENSITY
Electro-optics engineering support for the integrated launch and recovery television surveillance system
[AD-A223450] N90-29406
LUNGS
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling
[LR-625] N90-29772

M

MACH-ZEHNDER INTERFEROMETERS
Interferometry N90-29315
MACHINE LEARNING
An improved adaptive control for repetitive motion of robots N90-29831
Instruction dialogues: Teaching new skills to a robot N90-29884
Reactive behavior, learning, and anticipation N90-29908
Machine learning
[AD-A223732] N90-29988
MACHINING
A cost-effective realization of environmental temperature control
[DE90-011651] N90-29532
Non-contact contour gage
[DE90-014672] N90-29642
MAGNESIUM ALLOYS
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
MAGNETIC ANOMALIES
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
Some aspects of the structure and evolution of oceanic spreading centers N90-29757
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
MAGNETIC CLOUDS
Interstellar magnetic fields: An observational perspective N90-30144
MAGNETIC EFFECTS
Three dimensional studies of helical equilibria and magnetic surface breaking due to the finite beta effect
[DE90-508078] N90-30071
MAGNETIC FIELD RECONNECTION
A study of magnetic field reconnection and plasma processes in the magnetosphere
[DE90-016117] N90-29741
MAGNETIC FIELDS
Theoretical and experimental examinations of brushless monophase direct current motors
[ETN-90-97301] N90-29580
A review of self generated B-field in ICF corona
[DE90-627479] N90-30063
Tokamak plasma shape identification with a Legendre-Fourier expansion of the vacuum poloidal flux function in the toroidal coordinates
[DE90-508031] N90-30068
Structure of magnetic field in tokamaks
[DE90-628904] N90-30075
Magnetic surfaces in tokamaks
[DE90-628905] N90-30076
Lectures in plasma diagnostics
[DE90-015825] N90-30086
Compact toroid research
[DE90-016123] N90-30087
MAGNETIC FLUX
Interstellar magnetic fields: An observational perspective N90-30144
MAGNETIC MATERIALS
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers
[AD-A223409] N90-29509
Some aspects of the structure and evolution of oceanic spreading centers N90-29757
MAGNETIC MEASUREMENT
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
MAGNETIC PERMEABILITY
Sigma and pi interactions of the pyrrolic ligand sandwich-like lanthanide phthalocyanines determined from magnetic susceptibility and ligand-field theory
[AD-A223609] N90-29444
MAGNETIC PROPERTIES
Investigation of the application in the simulation program 'PSpice' of the Jiles-Atherton model for nonlinear magnetic materials in order to predict the degaussing of magnets
[LINO-1990-1] N90-30029
MAGNETIC RESONANCE
Medium energy nuclear physics research
[DE90-015852] N90-30042
MAGNETIC SPECTROSCOPY
Lectures in plasma diagnostics
[DE90-015825] N90-30086
MAGNETIC STORAGE
Theoretical investigations of Pi-conjugated polyradicals as models for organic magnetic materials
[AD-A223411] N90-29461
MAGNETIC STORMS
Atmospheric structure and variability
[AD-A223439] N90-29734
MAGNETIC VARIATIONS
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724
MAGNETIZATION
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088
MAGNETOHYDRODYNAMIC GENERATORS
Diagnostic development and support of MHD test facilities
[DE90-015403] N90-30083
MAGNETOHYDRODYNAMIC STABILITY
Ionospheric irregularities: Source, structure, plasma processes and effects on sensor systems
[AD-A223908] N90-29723
Unstable phenomena in mechanical systems
[AD-A223640] N90-30001
Transport of nonneutral plasmas
[AD-A223457] N90-30077
Control of helium accumulation
[DE90-015658] N90-30084
MAGNETOHYDRODYNAMICS
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724
Beam and plasma physics research
[AD-A224452] N90-30067
Transformation group methods in plasma physics
[DE90-628755] N90-30074
MAGNETOMETERS
Brorfelde Geomagnetic Observatory: Magnetic results, 1987
[ISBN-87-7478-297-5] N90-29756
MAGNETOSTATICS
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571
MAGNETRON SPUTTERING
Special purpose spatial light modulators
[AD-A223784] N90-30052
MAGNETRONS
High power microwaves for defense and accelerator applications
[AD-A223550] N90-29572

MAINTAINABILITY
Application of multifunction inertial reference systems to fighter aircraft N90-29341
Performance monitoring, fault detection, fault localization design guidance [AD-A223619] N90-29655
MAINTENANCE
Aircraft battle damage repair of transparencies [AD-A224168] N90-29387
Estimation of power spectral density of runway roughness [NAL-TR-1037] N90-29411
Oxygen deficiency monitor system [DE90-014866] N90-29917
MAN MACHINE SYSTEMS
Proceedings of the NASA Conference on Space Telerobotics, volume 3 [NASA-CR-186858] N90-29780
A design strategy for autonomous systems N90-29818
Use of graphics in decision aids for telerobotic control: (Parts 5-8 of an 8-part MIT progress report) N90-29829
Proceedings of the NASA Conference on Space Telerobotics, volume 4 [NASA-CR-186859] N90-29830
Global models: Robot sensing, control, and sensory-motor skills N90-29849
Proceedings of the NASA Conference on Space Telerobotics, volume 5 [NASA-CR-186860] N90-29874
The telerobot workstation testbed for the shuttle aft flight deck: A project plan for integrating human factors into system design N90-29887
Next generation space robot N90-29899
An intelligent, free-flying robot N90-29912
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network [AD-A223738] N90-29948
MAN TENDED FREE FLYERS
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
MAN-COMPUTER INTERFACE
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network [AD-A223738] N90-29948
Unstructured mesh relaxation [DE90-015614] N90-29989
MANAGEMENT
Total quality management: A recipe for success [AD-A223287] N90-30122
MANAGEMENT METHODS
AutoPAVER: A software package for automated pavement evaluation [AD-A224176] N90-29531
MANAGEMENT PLANNING
AutoPAVER: A software package for automated pavement evaluation [AD-A224176] N90-29531
Total quality management: A recipe for success [AD-A223287] N90-30122
MANAGEMENT SYSTEMS
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing [AD-A224510] N90-29543
MANEUVERABILITY
Analysis of dynamic transient response and postflutter behavior of super-maneuvering airplane [AD-A224126] N90-29386
Fighter agility metrics [NASA-CR-187289] N90-29389
MANGANIN (TRADEMARK)
A review of manganin gauge technology for measurements in the gigapascal range [MRL-TR-90-5] N90-30026
MANIFOLDS (MATHEMATICS)
On equations of motion on complex Grassman manifold [DE90-628369] N90-29999
MANIPULATORS
Quick-connect coupler for remote manipulation [DE90-015352] N90-29648
Robots, systems, and flexible automation [DE90-015802] N90-29649
Modeling, design, and control of flexible manipulator arms: Status and trends N90-29782
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
Capture of free-flying payloads with flexible space manipulators N90-29784
Technology and task parameters relating to the effectiveness of the bracing strategy N90-29785
Manipulators with flexible links: A simple model and experiments N90-29786
Experiments in identification and control of flexible-link manipulators N90-29787
Autonomous dexterous end-effectors for space robotics N90-29788
Traction-drive force transmission for telerobotic joints N90-29790
Force/torque and tactile sensors for sensor-based manipulator control N90-29791
Redundant sensorized arm+hand system for space telerobotized manipulation N90-29792
Impedance hand controllers for increasing efficiency in teleoperations N90-29793
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794
An advanced telerobotic system for shuttle payload changeout room processing applications N90-29795
Robotic tele-existence N90-29796
Redundancy of space manipulator on free-flying vehicle and its nonholonomic path planning N90-29797
Telepresence system development for application to the control of remote robotic systems N90-29799
The 3D model control of image processing N90-29800
Use of 3D vision for fine robot motion N90-29804
Telerobotic workstation design aid N90-29805
Modeling and sensory feedback control for space manipulators N90-29807
Autonomous sensor-based dual-arm satellite grappling N90-29809
Stability analysis of multiple-robot control systems N90-29811
Experiments in cooperative manipulation: A system perspective N90-29812
On the manipulability of dual cooperative robots N90-29813
Controlling multiple manipulators using RIPS N90-29814
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
The Goddard Space Flight Center (GSFC) robotics technology testbed N90-29825
Proceedings of the NASA Conference on Space Telerobotics, volume 4 [NASA-CR-186859] N90-29830
An improved adaptive control for repetitive motion of robots N90-29831
Direct adaptive control of a PUMA 560 industrial robot N90-29832
Model based manipulator control N90-29833
Discrete-time adaptive control of robot manipulators N90-29834
A discrete decentralized variable structure robotic controller N90-29835
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
The JAU-JPL anthropomorphic telerobot N90-29838
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
Sensor-based fine telemanipulation for space robotics N90-29841
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
How to push a block along a wall N90-29848
The 3-D vision system integrated dexterous hand N90-29850
Linear analysis of a force reflective teleoperator N90-29856
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Assembly of objects with not fully predefined shapes N90-29859
The effects of gear reduction on robot dynamics N90-29861
Recursive Newton-Euler formulation of manipulator dynamics N90-29862
Kinematic sensitivity of robot manipulators N90-29863
Efficient conjugate gradient algorithms for computation of the manipulator forward dynamics N90-29864
Determining robot actions for tasks requiring sensor interaction N90-29868
The laboratory telerobotic manipulator program N90-29869
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870
The control of space manipulators subject to spacecraft attitude control saturation limits N90-29871
Comparison of joint space versus task force load distribution optimization for a multiarm manipulator system N90-29873
Proceedings of the NASA Conference on Space Telerobotics, volume 5 [NASA-CR-186860] N90-29874
Telerobotic activities at Johnson Space Center N90-29875
Application of recursive manipulator dynamics to hybrid software/hardware simulation N90-29876
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877
Inverse dynamics of a 3 degree of freedom spatial flexible manipulator N90-29878
A control approach for robots with flexible links and rigid end-effectors N90-29879
Multi-level manual and autonomous control superposition for intelligent telerobot N90-29888
An alternative control structure for telerobotics N90-29889
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
On discrete control of nonlinear systems with applications to robotics N90-29893
A spatial operator algebra for manipulator modeling and control N90-29894
Flight experiments in telerobotics-Orbiter middeck concept N90-29895
Experimental study on two-dimensional free-flying robot satellite model N90-29896
The astronaut and the banana peel: An EVA retriever scenario N90-29897
Computed torque control of a free-flying cooperating-arm robot N90-29898
Computer simulation and design of a three degree-of-freedom shoulder module N90-29902
A collision avoidance system for a spaceplane manipulator arm N90-29903
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
An intelligent, free-flying robot N90-29912
MANUAL CONTROL
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
Multi-level manual and autonomous control superposition for intelligent telerobot N90-29888
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
MANUFACTURING
Realization of equipment for manufacturing titanium alloy electrodes for first step melting [ONERA-RT-15/3578-M] N90-29498
Proceedings of the 14th Annual Electronics Manufacturing Seminar [AD-A224276] N90-29563
Vacuum mechatronics N90-29854
MANY BODY PROBLEM
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium [AD-A223357] N90-29460
MAPPING
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand [PB90-230095] N90-29691
Proceedings of the 17th Annual Gravity Gradiometer Conference [AD-A223568] N90-29735
Symmetry and island structure of the standard map [DE90-508076] N90-30069
MARINE ENVIRONMENTS
Specification for a standard electromagnetic propagation model [AD-A223556] N90-29551
MARINE TRANSPORTATION
Combining LORAN and GPS: The best of both worlds N90-29343
Ring laser gyro marine inertial navigation systems N90-29355
MARKET RESEARCH
The nuclear battery [DE90-630400] N90-29559
MARKOV PROCESSES
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic [AD-A223611] N90-29552

MARS SURFACE
The flight telerobotic servicer: NASA's first operational space robot N90-29781
MASERS
An x ray source for lithography
[AD-D014596] N90-29630
MASS SPECTRA
Emission of quick neutrons and non-equilibrium phenomena by central shocks in the reaction 40 Ar + 40 Ca at 20 MeV/u
[ETN-90-97296] N90-30043
MASS SPECTROSCOPY
Proceedings of a discussion meeting on Thermodynamics of Alloys
[AD-A224336] N90-29476
Production of NO, NO2 and N2O in air by breakdown with high power microwaves: A preliminary report
[AD-A223297] N90-29749
MASSIFS
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691
MASSIVELY PARALLEL PROCESSORS
Fault tolerant design for multistage routing networks
[AD-A224267] N90-29978
MATERIALS TESTS
Tests for aircraft interior materials in fire accident
[LR-622] N90-29337
MATHEMATICAL MODELS
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE)
[NAL-TR-1028] N90-29330
State estimation for systems moving through random fields N90-29373
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
Nonlinear modeling of joint dominated structures
[NASA-CR-4324] N90-29423
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29466
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies
[AD-A224358] N90-29539
Specification for a standard electromagnetic propagation model
[AD-A223556] N90-29551
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic
[AD-A223611] N90-29552
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587
Finite difference modeling of laser diode ignited components
[DE90-015652] N90-29635
Modeling towed cable system dynamics
[AD-A223610] N90-29644
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
NASA radiation belt models AP-8 and AE-8
[AD-A223660] N90-29737
A study of magnetic field reconnection and plasma processes in the magnetosphere
[DE90-016117] N90-29741
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
The effect of wave data assimilation on the numerical simulation of wave energy advection
[KNMI-TR-121] N90-29760
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling
[LR-625] N90-29772
Modeling, design, and control of flexible manipulator arms: Status and trends N90-29782
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
Reflections on the relationship between artificial intelligence and operations research N90-29816
A discrete decentralized variable structure robotic controller N90-29835
How to push a block along a wall N90-29848
Linear analysis of a force reflective teleoperator N90-29856
A spatial operator algebra for manipulator modeling and control N90-29894
Communications Interface Driver (CID) software principles of operation
[DOT/FAA/CT-TN89/46] N90-29937
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954
Problems in probability, statistics, and reliability
[AD-A224152] N90-30016
Unification of statistical methods for continuous and discrete data
[AD-A224307] N90-30017
A new diagnostics approach for repeated measures designs
[AD-A223500] N90-30020
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033
A model of peaked density profile and inward pinch in tokamaks
[DE90-508079] N90-30072
MATHEMATICAL PROGRAMMING
Some studies related to a new Hexagonal Compound Parabolic Concentrator (HCPC) as a secondary in tandem with a solar tower
[DLR-FB-90-12] N90-29700
The effect of wave data assimilation on the numerical simulation of wave energy advection
[KNMI-TR-121] N90-29760
Formal verification of mathematical software, volume 2
[AD-A223633] N90-29943
MATRICES (MATHEMATICS)
Kalman filter formulations for transfer alignment of strapdown inertial units N90-29342
MATRIX MATERIALS
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
High performance brittle matrices and brittle matrix composites, book 2
[AD-A223274] N90-29441
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite
[AD-A223696] N90-29445
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
Non-destructive evaluation of infiltration-toughened ceramics
[DE90-629716] N90-29501
MAXIMUM LIKELIHOOD ESTIMATES
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
MEAN
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
MEASURING INSTRUMENTS
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
Non-contact contour gage
[DE90-014672] N90-29642
Multisensor evaluation framework
[AD-A224271] N90-29913
A review of manganin gauge technology for measurements in the gigapascal range
[MRL-TR-90-5] N90-30026
Diagnostic development and support of MHD test facilities
[DE90-015403] N90-30083
MECHANICAL DEVICES
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
MECHANICAL DRIVES
Traction-drive force transmission for telerobotic joints N90-29790
The effects of gear reduction on robot dynamics N90-29861
MECHANICAL PROPERTIES
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
Atomistic studies of grain boundaries in alloys and compounds
[DE90-012401] N90-29492
Fundamental studies on intermetallic compounds
[ONERA-RT-4/1855-M] N90-29497
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503
Thermal analysis of bismaleimide matrix resins
[DE90-016283] N90-29523
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions
[BR114894] N90-29646
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032
MEDIA
Microscopic models for electromagnetic wave propagation in highly dispersive media
[AD-A224382] N90-29540
MELTING
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
MELTS (CRYSTAL GROWTH)
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
MEMBRANES
Novel macrocyclic carriers for proton-coupled liquid membrane transport
[DE90-015529] N90-29453
MEMORY (COMPUTERS)
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
MENTAL HEALTH
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
MENTAL PERFORMANCE
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775
Ability and metacognitive determinants of skill acquisition and transfer
[AD-A224569] N90-29776
Physiological metrics of mental workload: A review of recent progress
[NASA-CR-187290] N90-29777
Automatic recognition of tractability in inference relations
[AD-A223698] N90-30003
MERCURY CADMIUM TELLURIDES
Research on mercury cadmium telluride
[AD-A224250] N90-29474
MESOMETEOROLOGY
Coordination of mesoscale meteorological research between ASL and European groups
[AD-A223811] N90-29751
MESOSCALE PHENOMENA
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746
Coordination of mesoscale meteorological research between ASL and European groups
[AD-A223811] N90-29751
MESSAGE PROCESSING
Observability of relative navigation using range-only measurements N90-29360
High speed bus technology development
[AD-A224486] N90-29565
METAL COATINGS
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098

METAL CRYSTALS
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095
METAL CUTTING
An effective low-profile thermite torch
[DE90-015746] N90-29534
METAL FATIGUE
Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design
[DE90-016039] N90-29491
METAL FILMS
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
METAL IONS
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695
METAL MATRIX COMPOSITES
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443
Microstructure of alpha-Al base matrix/SiC particulate composites
[DE90-014894] N90-29449
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
METAL OXIDE SEMICONDUCTORS
Extended characterization of the damage by hot charge carriers in gate oxide by short channel MOS field effect transistors
[ETN-90-97313] N90-30114
METAL POWDER
An effective low-profile thermite torch
[DE90-015746] N90-29534
METAL PROPELLANTS
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526
METAL SHEETS
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Fractographic analysis of fatigue crack growth under two-blocks loading on 2024-T351 sheet specimens
[LR-628] N90-29680
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
METAL SURFACES
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
An electron spin resonance study of adsorbed gases in ultrahigh vacuum
[ETN-90-97323] N90-29469
Scanning tunneling microscopy studies of chemisorbed layers on metal surfaces
[DE90-015623] N90-29486
A viscoelastic material model for computing stresses in glass
[DE90-014851] N90-29673
Light scattering from surface and sub-surface defects
[DE90-016311] N90-30058
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095
METALLIC STARS
An observational study of disk-population globular clusters N90-30145
METALLICITY
An observational study of disk-population globular clusters N90-30145
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152
METALS
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
METEOROLOGICAL PARAMETERS
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747
METEOROLOGICAL RESEARCH AIRCRAFT
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747
METEOROLOGY
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations
[NASA-TM-101880] N90-30123
METHANE
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-206588] N90-29701
METHOD OF MOMENTS
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29588
METHYL COMPOUNDS
Effect of particulate fillers on the rheology of polymer melts
[AD-A223601] N90-29512
MICHELSON INTERFEROMETERS
Velocity interferometry N90-29316
MICROBIOLOGY
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
MICROCOMPUTERS
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29691
Turbo pascal implementation of a distributed processing network of MS-DOS microcomputers connected in a master-slave configuration
[AD-A223925] N90-29928
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
A manual for microcomputer image analysis
[DE90-015629] N90-29958
Search strategies for computer-stored information: A microcomputer tutorial N90-30126
MICROELECTRONICS
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573
Controlling multiple manipulators using RIPS N90-29814
An advanced single event upset tester
[AD-A223613] N90-30163
MICROPARTICLES
Submicron particle analyzer
[AD-A223558] N90-30050
MICROPROCESSORS
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573
Approach to telerobot computing architecture
[NASA-CR-186993] N90-29984
Small multipurpose stored data acquisition system
[DE90-010823] N90-30134
MICROSTRUCTURE
The overall response of composite materials undergoing large elastic deformations
[AD-A224509] N90-29439
Microstructure of alpha-Al base matrix/SiC particulate composites
[DE90-014894] N90-29449
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
Effects of low Chromium(3) concentration in electrodeposition of low contraction chromium
[AD-A223338] N90-29477
A welding metallurgy study of Hastelloy Alloys B-2 and W
[DE90-011910] N90-29481
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
Single-phase solidification during rapid resolidification of stainless steel alloys
[DE90-015190] N90-29483
Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
Wear of advanced ceramics: An overview
[DE90-012166] N90-29519
Transmission electron microscopy study of ICB Al on Ge and Si(001) substrates
[DE90-015299] N90-30103
Advanced materials and electrochemical processes in high-temperature solid electrolytes
[DE90-015552] N90-30104
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
MICROWAVE FILTERS
Microwave active filters based on coupled negative resistance method
[AD-A223269] N90-29570
MICROWAVE FREQUENCIES
A global approach to image texture analysis
[AD-A223532] N90-29941
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143
MICROWAVE LANDING SYSTEMS
Analysis of the integrity of the Microwave Landing System (MLS) data functions N90-29365
MICROWAVE OSCILLATORS
High power microwaves for defense and accelerator applications
[AD-A223550] N90-29572
Beam and plasma physics research
[AD-A224452] N90-30067
MICROWAVES
Activities of the Division of Microwave Technology
[FOA-C-30555-3.2] N90-29537
Microwave background distortions from domain walls
[NASA-CR-187272] N90-29556
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
Reliability study of TWT output RF window
[AD-A223688] N90-29574
An x ray source for lithography
[AD-D014596] N90-29630
Production of NO, NO2 and N2O in air by breakdown with high power microwaves: A preliminary report
[AD-A223297] N90-29749
Beam and plasma physics research
[AD-A224452] N90-30067
MIDAIR COLLISIONS
UK airmisses involving commercial air transport: May - August 1989
[ISSN-0951-6301] N90-29335
MILITARY HELICOPTERS
The integration of multiple avionic sensors and technologies for future military helicopters N90-29344
MILITARY OPERATIONS
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
Electro-optics engineering support for the integrated launch and recovery television surveillance system
[AD-A223450] N90-29406
MILITARY TECHNOLOGY
Enhancing PLRS with user-to-user data capability N90-29359
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
MIMD (COMPUTERS)
The development and evaluation of numerical algorithms for MIMD computers
[NASA-TM-101167] N90-29939
Fault tolerant design for multistage routing networks
[AD-A224267] N90-29978
MINIATURIZATION
Modular digital GPS receivers N90-29346
MINICOMPUTERS
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948

MINIMAX TECHNIQUE
For the definition of two person zero sum games
[ETN-90-97294] N90-30022
MINING
Distributed communications and control network for robotic mining N90-29901
MIRRORS
XMM space telescope: Development plan for the lightweight replicated x ray gratings
[DE90-015620] N90-30055
MISALIGNMENT
Kalman filter formulations for transfer alignment of strapdown inertial units N90-29342
MISSILE CONTROL
Integrated strapdown avionics for precision guided vehicles N90-29361
MISSION PLANNING
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform
[NASA-CR-186226] N90-29381
Aircraft design for mission performance using nonlinear multiobjective optimization methods
[NASA-CR-4328] N90-29384
MIXING
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
Tail and quantile estimation for strongly mixing stationary sequences
[AD-A223472] N90-30019
MIXTURES
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
MOBILE COMMUNICATION SYSTEMS
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
MODEL REFERENCE ADAPTIVE CONTROL
Manipulators with flexible links: A simple model and experiments N90-29786
Model based manipulator control N90-29833
Discrete-time adaptive control of robot manipulators N90-29834
MODELS
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing
[AD-A224510] N90-29543
MODULATION
A 94 GHz transmissometer
[AD-A223309] N90-29618
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124
MODULATORS
Special purpose spatial light modulators
[AD-A223794] N90-30052
MOISTURE
Non-destructive method for environmental breakdown of graphite fiber reinforced polymer composites
[AD-A223729] N90-29515
MOISTURE CONTENT
The signals of an ice warning device in dependence on total water content and normalized icing degree
[ESA-TT-1207] N90-29692
MOLDING MATERIALS
Surface effect for test piece on flexural test of carbon fiber reinforced plastic laminates
[NAL-TM-601] N90-29436
MOLECULAR BEAM EPITAXY
Basic studies of 3-V high efficiency cell components
[DE90-000360] N90-29696
High throughput MBE materials for MODFET's
[AD-A223452] N90-30097
MOLECULAR CLOUDS
Interstellar magnetic fields: An observational perspective N90-30144
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151
MOLECULAR ELECTRONICS
Report on the International Workshop on Progress Towards Molecular Scale Electronics
[AD-A223758] N90-29575
MOLECULAR GASES
Interstellar magnetic fields: An observational perspective N90-30144
MOLECULAR INTERACTIONS
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459
MOLECULAR ORBITALS
An electron spin resonance study of adsorbed gases in ultrahigh vacuum
[ETN-90-97323] N90-29469
Atomistic studies of grain boundaries in alloys and compounds
[DE90-012401] N90-29492
MOLECULAR OSCILLATIONS
Spectroscopy of propellant-related flames
[AD-A224068] N90-29525
MOLECULAR SPECTROSCOPY
Proceedings of the 45th Ohio State University Symposium on Molecular Spectroscopy
[AD-A224349] N90-29457
MOLECULAR STRUCTURE
Proceedings of the 45th Ohio State University Symposium on Molecular Spectroscopy
[AD-A224349] N90-29457
Transition metal activation and functionalization of carbon-hydrogen bonds
[DE90-015826] N90-29489
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105
MOLECULES
Thermochemical data for silicon-containing species from ab initio electronic structure calculations
[DE90-011024] N90-29483
MOMENT DISTRIBUTION
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
MOMENTUM
A new momentum management controller for the space station
[NASA-CR-187265] N90-29425
The f2 dominance of the energy-momentum tensor
[DE90-508027] N90-29544
MOMENTUM TRANSFER
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
Medium energy nuclear physics research
[DE90-015852] N90-30042
MONITORS
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
Integrated controls and health monitoring fiberoptic shaft monitor
[NASA-CR-185210] N90-29622
Oxygen deficiency monitor system
[DE90-014866] N90-29917
A distributed control and monitor system used in laser fusion research
[DE90-011483] N90-30078
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
MONKEYS
Renal response to seven days of lower body positive pressure in the squirrel monkey
[NASA-CR-183355] N90-29761
MONOCHROMATIC RADIATION
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133
MONOMERS
Progress toward synthesis of polymeric polyradicals
[AD-A223414] N90-29510
MONTE CARLO METHOD
Techniques for autonomous GPS integrity monitoring N90-29345
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
Radar clutter via ray methods
[AD-A223796] N90-29553
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996
Trapezoidal stratified Monte Carlo integration
[AD-A223565] N90-30021
Monte Carlo simulation of complex spectra for opacity calculations
[DE90-015198] N90-30147
MOODS
Coping strategies and mood during cold weather training
[AD-A223915] N90-29773
MORPHOLOGY
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503
Effect of particulate fillers on the rheology of polymer melts
[AD-A223601] N90-29512
MOTION PERCEPTION
Direct estimation of structure and motion from multiple frames
[AD-A223903] N90-29985
MOTION SICKNESS
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767
MOTION SIMULATION
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767
The control of space manipulators subject to spacecraft attitude control saturation limits N90-29871
Directing an animated scene with autonomous actors
[REPT-89-041] N90-29972
MOTIVATION
Ability and metacognitive determinants of skill acquisition and transfer
[AD-A224569] N90-29776
MOTORS
Utilization of a measurement process by the examination of universal motors
[ETN-90-97307] N90-29581
MTBF
Techniques for developing a system safety risk assessment model
[AD-A223477] N90-29654
MULTIPLEXING
Integration of GPS and strapdown inertial subsystems into a single unit N90-29340
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system
[DE90-015203] N90-29620
MULTIPROCESSING (COMPUTERS)
A discrete decentralized variable structure robotic controller N90-29835
Fast algorithms for parallel architectures
[AD-A223731] N90-29947
Fact system: A standardizing modelization processing for concurrent systems
[ETN-90-97286] N90-29982
MULTISENSOR APPLICATIONS
An integrated system for land navigation N90-29377
MULTISTATIC RADAR
Activities of the Division of Microwave Technology
[FOA-C-30555-3.2] N90-29537
Bistatic radar cross section of a perfectly conducting rhombus-shaped flat plate
[AD-A223418] N90-29546
MULTIVARIATE STATISTICAL ANALYSIS
Sensitivity of the error in multivariate statistical interpolation to parameter values
[AD-A224076] N90-30015
A new diagnostics approach for repeated measures designs
[AD-A223500] N90-30020
MUSCULAR FUNCTION
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769

N

N-TYPE SEMICONDUCTORS
Research on mercury cadmium telluride
[AD-A224250] N90-29474
Surface photovoltage spectroscopy of real n-type GaAs(110) surfaces
[DE90-627325] N90-30092
NAP-OF-THE-EARTH NAVIGATION
Survivable penetration N90-29363

NASA SPACE PROGRAMS
NASA authorization, 1991, volume 2
[GPO-32-196] N90-30138
NATURAL LANGUAGE (COMPUTERS)
Instruction dialogues: Teaching new skills to a robot N90-29854
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
Textual regularities applicable to full text searching: The case of family history literature N90-30125
NAVIER-STOKES EQUATION
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1048] N90-29326
A boundary-layer transition model for the Navier-Stokes computation for a natural-laminar-flow airfoil
[NAL-TR-1038T] N90-29328
Some topics in computational transonic aerodynamics: Revision
[NAL-TR-1018T] N90-29332
Calibration of the PARC program for propulsion-type flows
[AD-A224253] N90-29395
An additive turbulent decomposition of the Navier-Stokes equations implemented on highly parallel computer systems
[AD-A223678] N90-29595
Secondary flow in presence of wall jets: Incorporation of compression effects in a quasi-elliptic Navier-Stokes calculation code
[ETN-90-97559] N90-29602
Parallelization of a method for solving three dimensional Navier-Stokes equations on a distributed memory multiprocessor
[ONERA-RTS-1/3717-CY] N90-29983
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
NAVIGATION
Modular digital GPS receivers N90-29346
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350
Distributed control architecture for CNI preprocessors N90-29356
An integrated system for land navigation N90-29377
NAVIGATION AIDS
The 2-D and 3-D characterizations of GPS navigation service N90-29348
Enhancing PLRS with user-to-user data capability N90-29359
Observability of relative navigation using range-only measurements N90-29360
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
A land navigation demonstration vehicle with a color map display for tactical use N90-29375
NAVIGATION INSTRUMENTS
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735
NAVIGATION SATELLITES
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364
NAVSTAR SATELLITES
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
NEAR FIELDS
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
NEAR ULTRAVIOLET RADIATION
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064
NEGATIVE RESISTANCE CIRCUITS
Microwave active filters based on coupled negative resistance method
[AD-A223269] N90-29570
NEON
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460
NETWORK ANALYSIS
Using minimal spanning trees to compare the reliability of network topologies
[NASA-TM-4208] N90-30014
NEURAL NETS
Integrating rule-based and neural-net techniques for spectral analysis
[AD-A223517] N90-29462
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic
[AD-A223611] N90-29552
Neural networks and radar systems
[FEL-89-B65] N90-29558
Macro cell placement with neural net algorithms
[REPT-90-020] N90-29585
Neural nets and eddy-current testing
[DE90-016044] N90-29656
A procedure concept for local reflex control of grasping N90-29839
NEURONS
Hitting lines with two-dimensional Brownian motion
[AD-A223595] N90-30027
NEUTRAL GASES
Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
NEUTRINOS
Search for neutrino events in the Kamiokande-2 detector in correlation with the solar-flare activity in March 1989
[DE90-508085] N90-30160
NEUTRON CROSS SECTIONS
Emission of quick neutrons and non-equilibrium phenomena by central shocks in the reaction 40 Ar + 40 Ca at 20 MeV/u
[ETN-90-97296] N90-30043
NEUTRON EMISSION
Emission of quick neutrons and non-equilibrium phenomena by central shocks in the reaction 40 Ar + 40 Ca at 20 MeV/u
[ETN-90-97296] N90-30043
NEUTRON IRRADIATION
Swelling of neutron irradiated vanadium alloys
[DE90-015294] N90-29472
NEUTRON SPECTRA
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485
NEUTRONS
Accurate calculations of neutron kerma and damage from ENDF/B-VI evaluations for silicon, chromium, iron and nickel, and comparison with ENDF/B-V results
[DE90-016020] N90-29674
NEW ZEALAND
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691
NEWTON METHODS
Recursive Newton-Euler formulation of manipulator dynamics N90-29862
The location of zeros using generalizations of Newton's method
[DE90-627168] N90-30023
NICKEL
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29466
Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494
NICKEL ALLOYS
Oxidation of NiAl(110)
[DE90-015645] N90-29487
Isotopic tailoring and other techniques used to study helium effects in austenitic alloys
[DE90-016344] N90-29495
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
Fundamental studies on intermetallic compounds
[ONERA-RT-4/1855-M] N90-29497
NITRATES
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29466
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
NITRIC ACID
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
NITRILES
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503
NITROGEN
Electron-beam fluorescence measurements in hypersonic flows N90-29318
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747
NITROGEN DIOXIDE
An electron spin resonance study of adsorbed gases in ultrahigh vacuum
[ETN-90-97323] N90-29469
Production of NO, NO2 and N2O in air by breakdown with high power microwaves: A preliminary report
[AD-A223297] N90-29749
NITROGEN OXIDES
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29728
NITROUS OXIDES
Production of NO, NO2 and N2O in air by breakdown with high power microwaves: A preliminary report
[AD-A223297] N90-29749
NOISE INTENSITY
Audibility and annoyance of en route noise of unducted fan engines
[AD-A223687] N90-30035
NOISE MEASUREMENT
Technique for the measurement of noise of the flow associated to the small wave numbers of the turbulence spectra
[ETN-90-97558] N90-29601
NOISE PREDICTION (AIRCRAFT)
Assessment System for Aircraft Noise (ASAN): Development of alpha-test prototype system software
[AD-A223770] N90-30036
NOISE REDUCTION
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A224392] N90-29725
NOISE SPECTRA
Inertial grade fiber gyros N90-29353
NOISE TOLERANCE
Workshop on Low Level Flight Training
[AGARD-AR-288] N90-29404
NONDESTRUCTIVE TESTS
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates
[AD-A223451] N90-29442
Non-destructive evaluation of infiltration-toughened ceramics
[DE90-629716] N90-29501
Non-destructive method for environmental breakdown of graphite fiber reinforced polymer composites
[AD-A223729] N90-29515
Nondestructive material characterization
[DE90-015176] N90-29652
NONEQUILIBRIUM CONDITIONS
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300
NONHOLONOMIC EQUATIONS
Redundancy of space manipulator on free-flying vehicle and its nonholonomic path planning N90-29797
NONLINEAR EQUATIONS
Uniform dissipative solutions for some fourth order nonlinear differential equations
[DE90-627151] N90-29991
An existence theorem for periodic solutions and applications to some third order nonlinear differential equations
[DE90-627152] N90-29992
Oscillatory and nonoscillatory behaviour of solutions of an equation alternately of retarded and advanced type
[DE90-627159] N90-29993
A posteriori error estimates for parametrized nonlinear equations
[AD-A224067] N90-29997
Symmetry and island structure of the standard map
[DE90-508076] N90-30069
NONLINEAR OPTICS
Analysis and evaluation of technical data on the photochronic and non-linear optical properties of materials
[AD-A223855] N90-30053
NONLINEAR PROGRAMMING
New approaches to linear and nonlinear programming
[AD-A224328] N90-29932

NONLINEAR SYSTEMS
Laser physics and laser spectroscopy
[AD-A224379] N90-29628
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
Research in nonlinear water waves
[AD-A224065] N90-29759
An improved adaptive control for repetitive motion of robots N90-29831
On discrete control of nonlinear systems with applications to robotics N90-29893
An efficient temporal logic for robotic task planning N90-29906

NONLINEARITY
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
Aircraft design for mission performance using nonlinear multiobjective optimization methods
[NASA-CR-4328] N90-29384
Nonlinear modeling of joint dominated structures
[NASA-CR-4324] N90-29423
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659
Windshear estimation along the trajectory of an aircraft N90-29745
Investigation of the application in the simulation program 'PSpice' of the Jiles-Atherton model for nonlinear magnetic materials in order to predict the degaussing of magnets
[LINO-1990-1] N90-30029
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031

NONPARAMETRIC STATISTICS
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016127] N90-29962

NONUNIFORM PLASMAS
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064

NORMAL DENSITY FUNCTIONS
Hitting lines with two-dimensional Brownian motion
[AD-A223595] N90-30027

NORMALITY
Norms and perception of events
[AD-A224236] N90-29774

NORTH AMERICA
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747

NOVA LASER SYSTEM
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system
[DE90-015203] N90-29620

NOVAE
The impact of IUE on studies of the nova outburst: 1986-1990
[DE90-014915] N90-30156

NUCLEAR ASTROPHYSICS
Prospects for nuclear astrophysics with intense radioactive ion beams
[DE90-015616] N90-30044

NUCLEAR ELECTRIC POWER GENERATION
The nuclear battery
[DE90-630400] N90-29559

NUCLEAR EXPLOSIONS
The Surface Air Sampling Program
[DE90-014873] N90-29711

NUCLEAR FUELS
Overview of advanced fuel fusion
[DE90-015660] N90-30085

NUCLEAR FUSION
Fundamental studies of fusion plasmas
[DE90-015732] N90-30080

NUCLEAR INTERACTIONS
Nucleus-nucleus collisions and the nuclear equation of state
[DE90-015427] N90-30037

NUCLEAR MAGNETIC RESONANCE
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088

NUCLEAR PHYSICS
Medium energy nuclear physics research
[DE90-015852] N90-30042

NUCLEAR POWER PLANTS
Neural nets and eddy-current testing
[DE90-016044] N90-29656

NUCLEAR REACTIONS
Accurate calculations of neutron kerma and damage from ENDF/B-VI evaluations for silicon, chromium, iron and nickel, and comparison with ENDF/B-V results
[DE90-016020] N90-29674
Prospects for nuclear astrophysics with intense radioactive ion beams
[DE90-015616] N90-30044

NUCLEAR REACTORS
The nuclear battery
[DE90-630400] N90-29559
Counter-current flow limitation in thin rectangular channels
[DE90-015124] N90-29599

NUCLEAR RESEARCH
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis
[DE90-008944] N90-29778

NUCLEATION
Percolation and low density materials: Theory and applications
[AD-A224237] N90-29438
Mechanism of habit change for atmospheric ice crystal growth N90-29717

NUCLEI
Heavy Nucleus Collector (HNC) project for the NASA Long Duration Exposure Facility (LDEF)
[NASA-CR-182094] N90-30045

NULL ZONES
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953

NUMERICAL ANALYSIS
Statistically designed study of the variables and parameters of carbon dioxide equations of state
[DE90-016196] N90-29467
A numerical study of the response of the laminar unsteady separated flow about a circular cylinder to changes of boundary conditions
[DLR-FB-90-10] N90-29613
A vector diagram approach to shaping inputs for vibration reduction
[AD-A223724] N90-29671
Formal verification of mathematical software, volume 2
[AD-A223633] N90-29943

NUMERICAL CONTROL
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942

NUMERICAL FLOW VISUALIZATION
Calculation of flow fields by the solution of the Euler equations using an extended finite volume discretization scheme
[ESA-TT-1204] N90-29605

NUMERICAL INTEGRATION
Calculation of turbulent air streams in driver cabs
[ETN-90-97320] N90-29310
Tests of initialization procedures with the NRL limited area numerical weather prediction model
[AD-A223549] N90-29750
Analytic least squares
[NPL-DES-86] N90-29971
Solution of nonlinear eigenvalue problems via parallel shooting
[LR-587] N90-30013

NUMERICAL WEATHER FORECASTING
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
Tests of initialization procedures with the NRL limited area numerical weather prediction model
[AD-A223549] N90-29750

NYLON (TRADEMARK)
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459

NYSTAGMUS
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767

O

O RING SEALS
Compatibility of elastomeric seal compounds with MIL-H-6083 and MIL-H-46170 hydraulic fluid
[AD-A224248] N90-29504
Leak detection aid
[DE90-014678] N90-29616

OBJECT PROGRAMS
Tutorial on using LISP object-oriented programming for blackboards: Solving the radar tracking problem
[AD-A224272] N90-29930
A survey of object-oriented database technology
[AD-A224490] N90-30130

OBSERVABILITY (SYSTEMS)
Observability of relative navigation using range-only measurements N90-29360

OBSTACLE AVOIDANCE
Guidance algorithms for a free-flying space robot N90-29798

OCCULTATION
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29718
Formation of hydrogen line and continuum emission in young stellar objects N90-30150

OCEAN BOTTOM
Some aspects of the structure and evolution of oceanic spreading centers N90-29757

OCEAN MODELS
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033

OCEAN SURFACE
Research in nonlinear water waves
[AD-A224065] N90-29759

OCEANS
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758

OIL EXPLORATION
Applications of differential GPS N90-29349

OIL RECOVERY
Statistically designed study of the variables and parameters of carbon dioxide equations of state
[DE90-016196] N90-29467

OLIGOMERS
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers
[AD-A223409] N90-29509

OMEGA NAVIGATION SYSTEM
Overview of Omega signal coverage N90-29368
Omega navigation signal characteristics N90-29369

ON-LINE SYSTEMS
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
Supporting large scale applications on networks of workstations
[NASA-CR-186346] N90-29975
Low cost management of replicated data in fault-tolerant distributed systems
[NASA-CR-186370] N90-29976
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137

ONBOARD DATA PROCESSING
Database development for the DMSP experiments
[AD-A224346] N90-30129

OPACITY
Monte Carlo simulation of complex spectra for opacity calculations
[DE90-015198] N90-30147

OPEN CLUSTERS
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151

OPERATING COSTS
Airline productivity relating on the fuel cost. (2): Fuel consumption values and fuel efficiency
[NAL-TM-604-2] N90-29333
The cost of air service fragmentation
[TT-9010] N90-29334

OPERATING SYSTEMS (COMPUTERS)
System software for Soviet computers N90-29921
Programming your way out of the past: ISIS and the META Project
[NASA-CR-186275] N90-29922
AHTO project: Software technology for open distributed processing
[PB90-190943] N90-29923
Language and system support for concurrent programming
[AD-A223760] N90-29949
Low cost management of replicated data in fault-tolerant distributed systems
[NASA-CR-186370] N90-29976

OPERATIONS RESEARCH
ECS: Sixth year in orbit
[ESA-BR-70] N90-29428
Reflections on the relationship between artificial intelligence and operations research N90-29816
Preliminary hazard analysis in design application to EVA space suit
[ETN-90-97585] N90-29918
New approaches to linear and nonlinear programming
[AD-A224328] N90-29932
OPERATOR PERFORMANCE
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
Multisensor evaluation framework
[AD-A224271] N90-29913
OPERATORS (PERSONNEL)
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis
[DE90-008944] N90-29778
OPTICAL BISTABILITY
Optical nonlinearity due to structure defects and bistability in the band discontinuity area of CdS
[ETN-90-97303] N90-30112
OPTICAL COMMUNICATION
Satellite Constellation Orbit Evaluation (SCORE) program
[AD-A223531] N90-29417
OPTICAL COUPLING
Image amplification in photoreactive crystals and utilization in optical reaction systems
[ETN-90-97285] N90-30059
OPTICAL DATA PROCESSING
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
[AD-A224239] N90-29538
Optical symbolic processor for expert system execution
[AD-A224284] N90-29931
Optical signal computing
[AD-A223624] N90-30051
OPTICAL EQUIPMENT
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
Analysis and evaluation of technical data on the photochronic and non-linear optical properties of materials
[AD-A223855] N90-30053
OPTICAL GYROSCOPES
Inertial grade fiber gyros N90-29353
OPTICAL HETERODYNING
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146
OPTICAL MATERIALS
Nonlinear optical studies of the optical and electronic properties of semiconductor heterostructures
[AD-A223408] N90-30096
OPTICAL MEASUREMENT
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
OPTICAL MEASURING INSTRUMENTS
Detectors and signal processing for the speed measuring system 4-01
[FEL-1989-64] N90-29623
OPTICAL MEMORY (DATA STORAGE)
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
[AD-A224239] N90-29538
OPTICAL PROPERTIES
Two terminal CuInSe2 based cascade cells
[DE90-000363] N90-29697
Quantum well infrared detectors 1: Some calculations of their optical properties
[RSRE-MEMO-4363] N90-30062
OPTICAL PUMPING
Model calculations for a 600 angstrom laser based on photopumping of Mo(sup 6+) by a spectral line of Mo(sup 11+)
[DE90-015202] N90-29634
A distributed control and monitor system used in laser fusion research
[DE90-011483] N90-30078
OPTICAL TRANSITION
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
Establishment of a capability to measure optical transition radiation
[AD-A224094] N90-30047
OPTIMAL CONTROL
Control and estimation for aerospace applications with system time delays N90-29367
Optimal trajectories for hypervelocity flight N90-29378
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Time optimal movement of cooperating robots N90-29815
Recursive multibody dynamics and discrete-time optimal control N90-29860
OPTIMIZATION
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
Aircraft design for mission performance using nonlinear multiobjective optimization methods
[NASA-CR-4328] N90-29384
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
Optimization of tetrahedrical meshes for finite element calculation methods in fluids mechanics
[ETN-90-97560] N90-29603
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions
[BR114894] N90-29646
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
Parallel and sparse methods for large-scale numerical optimization
[DE90-015655] N90-29959
Analytic least squares
[NPL-DES-86] N90-29971
Unique binary search tree representations and equality-testing of sets and sequences
[AD-A223643] N90-30002
A new look at conjugate direction methods of optimization
[MATHS-REPT-A-125] N90-30010
OPTOGALVANIC SPECTROSCOPY
Examinations of hyperfine structure and isotope displacement of the elements gadolinium and europium with laser fluorescence and two photon spectroscopy
[ETN-90-97312] N90-29468
ORBIT CALCULATION
Satellite motion in an axi-symmetric gravitational field. Part 1: Perturbations due to J2 (second order) and J3
[RAE-TR-88068] N90-29429
Thermal imaging assessment
[AD-A224400] N90-29542
ORBITAL ASSEMBLY
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
Interset: A natural language interface fc teleoperated robotic assembly of the EASE space structure N90-29885
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
ORBITAL SERVICING
Space robotic system for proximity operations N90-29806
Stability analysis of multiple-robot control systems N90-29811
The flight telerobotic servicer project: A technical overview N90-29821
The flight telerobotic servicer Tinman concept: System design drivers and task analysis N90-29822
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
The astronaut and the banana peel: An EVA retriever scenario N90-29897
Next generation space robot N90-29899
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
An intelligent, free-flying robot N90-29912
ORBITING LUNAR STATIONS
A lunar space station
[NASA-CR-186223] N90-30158
ORDER-DISORDER TRANSFORMATIONS
Percolation and low density materials: Theory and applications
[AD-A224237] N90-29438
Kinetic pathway in Stranski-Krastanov growth of Ge on Si(001)
[AD-A224324] N90-29456
Microscopic aspects of the initial stages of epitaxial growth. A scanning tunneling microscopy study
[AD-A224325] N90-30094
A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
ORGANIC COMPOUNDS
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers
[AD-A223409] N90-29509
ORGANIC MATERIALS
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Theoretical investigations of Pi-conjugated polyradicals as models for organic magnetic materials
[AD-A223411] N90-29461
ORGANIZATIONS
Working implementation agreements for open systems interconnection protocols
[PB90-197948] N90-30127
ORTHOGONALITY
Parallel architectures and algorithms for image understanding
[AD-A223479] N90-29940
OSCILLATIONS
Oscillatory and nonoscillatory behaviour of solutions of an equation alternately of retarded and advanced type
[DE90-627159] N90-29993
Adiabatic invariance and transient resonance in very slowly varying oscillatory Hamiltonian systems
[DE90-016118] N90-30007
New real space correlated-basis-functions approach for the electron correlations of the semiconductor inversion layer
[DE90-627315] N90-30090
OSCILLATORS
High voltage picosecond pulse generation using avalanche diodes
[DE90-015194] N90-29577
OXIDATION
Oxidation of NiAl(110)
[DE90-015645] N90-29487
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
OXIDATION RESISTANCE
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
High performance brittle matrices and brittle matrix composites, book 2
[AD-A223274] N90-29441
OXIDES
Extended characterization of the damage by hot charge carriers in gate oxide by short channel MOS field effect transistors
[ETN-90-97313] N90-30114
OXYGEN
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
Oxygen deficiency monitor system
[DE90-014866] N90-29917
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108
OZONE
Trend analysis of total ozone data N90-29703
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29728
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736

P

P-TYPE SEMICONDUCTORS
Research on mercury cadmium telluride
[AD-A224250] N90-29474
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100
PARALLEL COMPUTERS
An additive turbulent decomposition of the Navier-Stokes equations implemented on highly parallel computer systems
[AD-A223678] N90-29595
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29891
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953
Assembler for a parallel computer
[NAL-TM-586] N90-29974
A high-speed KDL-RAM file system for parallel computers
[AD-A223299] N90-29979
Innovative uses of parallel computers
[AD-A223578] N90-29980
PARALLEL PROCESSING (COMPUTERS)
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
[AD-A224239] N90-29538
Turbo pascal implementation of a distributed processing network of MS-DOS microcomputers connected in a master-slave configuration
[AD-A223925] N90-29928
Parallel architectures and algorithms for image understanding
[AD-A223479] N90-29940
Fast algorithms for parallel architectures
[AD-A223731] N90-29947
Parallel and sparse methods for large-scale numerical optimization
[DE90-015655] N90-29959
Developing tools for performance visualization of parallel algorithms
[DE90-015801] N90-29960
A parallel least squares collocation conjugate gradient approach for the advection diffusion equation
[DE90-015965] N90-29961
Assembler for a parallel computer
[NAL-TM-586] N90-29974
Fault tolerant design for multistage routing networks
[AD-A224267] N90-29978
Asynchronous design for parallel processing architectures
[AD-A223754] N90-29981
Fact system: A standardizing modelization processing for concurrent systems
[ETN-90-97286] N90-29982
Parallelization of a method for solving three dimensional Navier-Stokes equations on a distributed memory multiprocessor
[ONERA-RTS-1/3717-CY] N90-29983
PARALLEL PROGRAMMING
Durra: A task-level description language user's manual
[AD-A223761] N90-29950
PARAMETER IDENTIFICATION
Estimation and representation of multidimensional mappings
[DLR-MITT-90-06] N90-29967
Sensitivity of the error in multivariate statistical interpolation to parameter values
[AD-A224076] N90-30015
PARAMETERIZATION
A posteriori error estimates for parametrized nonlinear equations
[AD-A224067] N90-29997
Parametric testing for the RSRE CMOS, silicon on sapphire process
[RSRE-MEMO-4369] N90-30115
PARITY
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
PARTIAL DIFFERENTIAL EQUATIONS
Some overdetermined systems of complex partial differential equations
[DE90-627162] N90-29995
Transformation group methods in plasma physics
[DE90-628755] N90-30074
PARTICLE ACCELERATION
The Tempel 2 dust trail
[AD-A224395] N90-30153
PARTICLE ACCELERATORS
High power microwaves for defense and accelerator applications
[AD-A223550] N90-29572
PARTICLE COLLISIONS
Nucleus-nucleus collisions and the nuclear equation of state
[DE90-015427] N90-30037
New developments in low-energy cosmic gamma-ray detection
[UT-HE-90/07] N90-30165
PARTICLE EMISSION
The Tempel 2 dust trail
[AD-A224395] N90-30153
PARTICLE ENERGY
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
PARTICLE INTERACTIONS
Sigma and pi interactions of the pyrrolic ligand sandwich-like lanthanide phthalocyanines determined from magnetic susceptibility and ligand-field theory
[AD-A223609] N90-29444
PARTICLE MOTION
Particle dispersion in a turbulent shear flow
[AD-A224327] N90-29590
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
PARTICLE SIZE DISTRIBUTION
Microstructure of alpha-Al base matrix/SiC particulate composites
[DE90-014894] N90-29449
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526
Analysis of pyrotechnic devices by laser-illuminated high speed photography
[DE90-015741] N90-29530
The Tempel 2 dust trail
[AD-A224395] N90-30153
PARTICLE THEORY
Fast pulsars, strange stars: An opportunity in radio astronomy
[DE90-015630] N90-30155
PARTICLE TRACKS
New developments in low-energy cosmic gamma-ray detection
[UT-HE-90/07] N90-30165
PARTICLE TRAJECTORIES
A search for low energy cosmic ray antiprotons N90-30161
PARTICLES
Spatial structure of particle-orbit loss regions in l=2 helical systems
[DE90-508080] N90-30073
PARTICULATES
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
Effect of particulate fillers on the rheology of polymer melts
[AD-A223601] N90-29512
PASCAL (PROGRAMMING LANGUAGE)
Turbo pascal implementation of a distributed processing network of MS-DOS microcomputers connected in a master-slave configuration
[AD-A223925] N90-29928
PASSENGER AIRCRAFT
Aircraft evacuations: The effect of passenger motivation and cabin configuration adjacent to the exit
[CAA-PAPER-89019] N90-29336
PATTERN RECOGNITION
Detection and analysis of wind fronts and current shear in digital SAR images
[FFI-89/7016] N90-29755
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
A fast 3-D object recognition algorithm for the vision system of a special-purpose dexterous manipulator N90-29803
Recognition by linear combination of models
[AD-A224268] N90-29929
Machine recognition as representation and search
[AD-A223700] N90-29946
PATTERN REGISTRATION
Recognition by linear combination of models
[AD-A224268] N90-29929
PAYLOAD CONTROL
Capture of free-flying payloads with flexible space manipulators N90-29784
PAYLOAD DELIVERY (STS)
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
Optimal payload rate limit algorithm for zero-G manipulators N90-29858
PAYLOAD RETRIEVAL (STS)
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
PAYLOADS
Shuttle remote manipulator system mission preparation and operations N90-29909
Database development for the DMSP experiments
[AD-A224348] N90-30129
PENETRATION
Survivable penetration N90-29363
Design and evaluation of candidate pressure distribution and air data system tile penetration for the aeroassist flight experiment
[NASA-CR-4312] N90-29615
PERCEPTION
Ability and metacognitive determinants of skill acquisition and transfer
[AD-A224589] N90-29776
A layered abduction model of perception: Integrating bottom-up and top-down processing in a multi-sense agent N90-29851
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133
PERCOLATION
Percolation and low density materials: Theory and applications
[AD-A224237] N90-29438
PERFORATED PLATES
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber
[NAL-TM-603] N90-30030
PERFORATED SHELLS
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679
PERFORMANCE TESTS
State estimation for systems moving through random fields N90-29373
Recommended practices for measurement of gas path pressures and temperatures for performance assessment of aircraft turbine engines and components
[AGARD-AR-245] N90-29393
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
AutoPAVER: A software package for automated pavement evaluation
[AD-A224176] N90-29531
Radar receiver procedures
[AD-A224399] N90-29541
Performance test plan for variable-speed ac superconducting motor
[DE90-016208] N90-29579
A 94 GHz transmissometer
[AD-A223309] N90-29618
Integrated controls and health monitoring fiberoptic shaft monitor
[NASA-CR-185210] N90-29622
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
Multisensor evaluation framework
[AD-A224271] N90-29913
Survey of formal specification techniques for reactive systems
[AD-A223741] N90-30005
A reduced-order extended Kalman filter for moving images
[AD-A223742] N90-30028
Parametric testing for the RSRE CMOS, silicon on sapphire process
[RSRE-MEMO-4369] N90-30115
PERMEABILITY
Modification of polystyrene/polybutadiene block copolymer films by chemical reaction with bromine and effect on gas permeability
[AD-A223612] N90-29513
PERSONAL COMPUTERS
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
GSHELL: Multichannel analyzer/multichannel scaler emulation software for IBM-PC-compatible computers
[DE90-015396] N90-29956

Automated CADAM data transfer: User's manual
[DE90-014871] N90-29963
ESTEC software catalogue
[ESA-SP-1133] N90-29968
PERSONNEL
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770
Human error classification and data collection
[DE90-631408] N90-29915
PERTURBATION THEORY
Satellite motion in an axi-symmetric gravitational field. Part 1: Perturbations due to J2 (second order) and J3
[RAE-TR-88068] N90-29429
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460
Unstable phenomena in mechanical systems
[AD-A223640] N90-30001
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032
A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
On a calculation of the ground-state energy in quantum mechanics
[DE90-627182] N90-30119
Introductory lectures on conformal field theory and strings
[DE90-627219] N90-30120
PH FACTOR
Shear-resistant drag reduction polymers. Part 1: Molecular investigations of polymer drag reduction and the development of laboratory screening methods
[AD-A223353] N90-29508
PHARMACOLOGY
Pharmacological resetting of the circadian sleep-wake cycle effects of triazolam on reentrainment of circadian rhythms in a diurnal primate
[AD-A224227] N90-29764
PHASE DIAGRAMS
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102
PHASE LOCKED SYSTEMS
Integration of GPS/INS with partitioned filters N90-29347
PHASE MATCHING
Laser physics and laser spectroscopy
[AD-A224379] N90-29628
PHASE SHIFT
Novel approaches to sensitivity enhancement of ring laser gyros
[AD-A224335] N90-29617
PHASE TRANSFORMATIONS
Microwave background distortions from domain walls
[NASA-CR-187272] N90-29556
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102
PHENOLS
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Progress toward synthesis of polymeric polyradicals
[AD-A223414] N90-29510
PHONONS
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106
PHOSPHATES
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105
PHOSPHORIC ACID
Electrochemical characteristics of acid electrolytes for fuel cells
[PB90-244365] N90-29693
PHOSPHORUS
Thermographic phosphor technique N90-29324
PHOTOCATHODES
Long-term flat-field behavior in LLNL streak cameras: Preliminary results
[DE90-015615] N90-29621
PHOTOCHEMICAL REACTIONS
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers
[AD-A223409] N90-29509
Chemical stabilization of laser dyes
[AD-A224219] N90-29627
Trend analysis of total ozone data N90-29703
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
PHOTOCHROMISM
Analysis and evaluation of technical data on the photochronic and non-linear optical properties of materials
[AD-A223855] N90-30053
PHOTOIONIZATION
Formation of hydrogen line and continuum emission in young stellar objects N90-30150
PHOTOLUMINESCENCE
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106
PHOTONICS
Electronic and photonic power applications
[DE90-015567] N90-29698
PHOTOSYNTHESIS
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710
PHOTOVOLTAGES
Surface photovoltage spectroscopy of real n-type GaAs(110) surfaces
[DE90-627325] N90-30092
PHOTOVOLTAIC CONVERSION
Electronic and photonic power applications
[DE90-015567] N90-29698
PHOTOVOLTAIC EFFECT
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
Photoinduced and holographically reinforced light diffusion in electrooptic crystals
[ETN-90-97321] N90-30060
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100
PHTHALOCYANIN
Sigma and pi interactions of the pyrrolic ligand sandwich-like lanthanide phthalocyanines determined from magnetic susceptibility and ligand-field theory
[AD-A223609] N90-29444
PHYSIOLOGICAL RESPONSES
Renal response to seven days of lower body positive pressure in the squirrel monkey
[NASA-CR-183355] N90-29761
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767
PHYSIOLOGY
Physiological metrics of mental workload: A review of recent progress
[NASA-CR-187290] N90-29777
PICOSECOND PULSES
High voltage picosecond pulse generation using avalanche diodes
[DE90-015194] N90-29577
PIEZOELECTRIC CERAMICS
Piezoelectric and electrostrictive materials for transducer applications, volume 2
[AD-A223561] N90-29669
PIEZOELECTRIC TRANSDUCERS
Nondestructive material characterization
[DE90-015176] N90-29652
Piezoelectric and electrostrictive materials for transducer applications, volume 1
[AD-A223560] N90-29668
Piezoelectric and electrostrictive materials for transducer applications, volume 2
[AD-A223561] N90-29669
PIEZOELECTRICITY
Piezoelectric and electrostrictive materials for transducer applications, volume 1
[AD-A223560] N90-29668
PILOT PERFORMANCE
Workshop on Low Level Flight Training
[AGARD-AR-288] N90-29404
Visual processing: Implications for helmet mounted displays
[AD-A223488] N90-29916
PINCH EFFECT
A model of peaked density profile and inward pinch in tokamaks
[DE90-508079] N90-30072
PINS
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
PIPELINING (COMPUTERS)
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
PLANAR STRUCTURES
Optimal trajectories for hypervelocity flight N90-29378
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
PLANE STRAIN
Comparison of crack closure result obtained by 3D elastic-plastic FEM and modified Dugdale model
[FFA-TN-1990-18] N90-29675
PLANE WAVES
Elastic interfaces
[REPT-90-003] N90-29742
PLANETOLOGY
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations
[NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition
[NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations
[NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations
[NASA-TM-89695] N90-30148
PLANNING
Vehicle path-planning in three dimensions using optics analogs for optimizing visibility and energy cost N90-29853
Precedence relationship representations of mechanical assembly sequences N90-29866
The indexed time table approach for planning and acting N90-29907
PLASMA CHEMISTRY
Production of NO, NO2 and N2O in air by breakdown with high power microwaves: A preliminary report
[AD-A223297] N90-29749
PLASMA CONTROL
Spatial structure of particle-orbit loss regions in l=2 helical systems
[DE90-508080] N90-30073
Structure of magnetic field in tokamaks
[DE90-628904] N90-30075
Magnetic surfaces in tokamaks
[DE90-628905] N90-30076
PLASMA DECAY
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interactions
[AD-A224282] N90-30065
PLASMA DENSITY
A model of peaked density profile and inward pinch in tokamaks
[DE90-508079] N90-30072
UCD-LLNL collaboration on basic plasma physics research in inertial confinement fusion
[DE90-015771] N90-30081
PLASMA DIAGNOSTICS
Investigation of laser diagnostics of PACVO (Plasma Assisted Chemical Vapor Deposition) processes for depositing hard face coatings
[DE90-016209] N90-29522
Lectures in plasma diagnostics
[DE90-015825] N90-30086
Compact toroid research
[DE90-016123] N90-30087
PLASMA FREQUENCIES
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064
PLASMA HEATING
High average power CW FELS (Free Electron Laser) for application to plasma heating: Designs and experiments
[DE90-011085] N90-29633

Stochastic properties of the plasma wave heating map
[DE90-508077] N90-30070
A model of peaked density profile and inward pinch in tokamaks
[DE90-508079] N90-30072
Fundamental studies of fusion plasmas
[DE90-015732] N90-30080

PLASMA INTERACTIONS
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interaactions
[AD-A224282] N90-30065

PLASMA OSCILLATIONS
Control of helium accumulation
[DE90-015658] N90-30084

PLASMA PHYSICS
CARS spectroscopy and applications N90-29321
The worldwide ionospheric data base
[NASA-TM-101823] N90-29714
Beam and plasma physics research
[AD-A224452] N90-30067
Transformation group methods in plasma physics
[DE90-628755] N90-30074
Transport of nonneutral plasmas
[AD-A223457] N90-30077
UCD-LLNL collaboration on basic plasma physics research in inertial confinement fusion
[DE90-015771] N90-30081

PLASMA PUMPING
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064

PLASMA SHEATHS
Lectures in plasma diagnostics
[DE90-015825] N90-30086

PLASMA SPECTRA
Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099

PLASMA WAVES
Stochastic properties of the plasma wave heating map
[DE90-508077] N90-30070
Structure of magnetic field in tokamaks
[DE90-628904] N90-30075

PLASMAS (PHYSICS)
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
Investigation of laser diagnostics of PACVO (Plasma Assisted Chemical Vapor Deposition) processes for depositing hard face coatings
[DE90-016209] N90-29522
Ionospheric irregularities: Source, structure, plasma processes and effects on sensor systems
[AD-A223908] N90-29723
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
A study of magnetic field reconnection and plasma processes in the magnetosphere
[DE90-016117] N90-29741
A review of self generated B-field in ICF corona
[DE90-627479] N90-30063
Tokamak plasma shape identification with a Legendre-Fourier expansion of the vacuum poloidal flux function in the toroidal coordinates
[DE90-508031] N90-30068
Fundamental studies of fusion plasmas
[DE90-015732] N90-30080

PLASTIC DEFORMATION
Comparison of crack closure result obtained by 3D elastic-plastic FEM and modified Dugdale model
[FFA-TN-1990-18] N90-29675
A method for modeling kinematic hardening and cyclic strain effects
[ONERA-RT-77/1765-RY-089-R] N90-29677

PLASTIC PROPERTIES
Studies on crack mechanics
[AD-A223634] N90-29670
A method for modeling kinematic hardening and cyclic strain effects
[ONERA-RT-77/1765-RY-089-R] N90-29677

PLASTICS
Aircraft battle damage repair of transparencies
[AD-A224168] N90-29387

PLATE THEORY
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658

PLATES (STRUCTURAL MEMBERS)
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659

PLATINUM
Scanning tunneling microscopy studies of chemisorbed layers on metal surfaces
[DE90-015623] N90-29486

PLOTTING
Realtime multi-plot graphics system
[NASA-CR-4304] N90-29919

PLUMES
Barotropic mechanisms associated with tropical plume formation N90-29719
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721

POINTING CONTROL SYSTEMS
Pointing control system for the Teal Ruby experiment N90-29370

POLAR ORBITS
Database development for the DMSP experiments
[AD-A224346] N90-30129

POLAR REGIONS
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
Studies of ionospheric dynamics utilizing data from DMSP
[AD-A223370] N90-29733

POLICIES
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704

POLISHING
Lapping: Polishing and shear mode grinding
[DE90-015188] N90-29533

POLLUTION CONTROL
Environmental quality, 1970 - 1990
[PB90-214610] N90-29705
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712

POLLUTION TRANSPORT
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747

POLOIDAL FLUX
Tokamak plasma shape identification with a Legendre-Fourier expansion of the vacuum poloidal flux function in the toroidal coordinates
[DE90-508031] N90-30068

POLYAMIDE RESINS
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459

POLYATOMIC MOLECULES
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066

POLYBUTADIENE
Modification of polystyrene/polybutadiene block copolymer films by chemical reaction with bromine and effect on gas permeability
[AD-A223612] N90-29513

POLYCRYSTALS
Polycrystalline diamond Junction Field Effect Transistors (JFETS)
[AD-A223784] N90-29576

POLYMER CHEMISTRY
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Processing of polymers using supercritical fluids
[AD-A223681] N90-29514

POLYMERIC FILMS
Modification of polystyrene/polybutadiene block copolymer films by chemical reaction with bromine and effect on gas permeability
[AD-A223612] N90-29513

POLYMERIZATION
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers
[AD-A223409] N90-29509
Progress toward synthesis of polymeric polyradicals
[AD-A223414] N90-29510
Chemical stabilization of laser dyes
[AD-A224219] N90-29627

POLYMETHYL METHACRYLATE
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435

POLYNOMIALS
Automatic recognition of tractability in inference relations
[AD-A223698] N90-30003

POLYSTYRENE
Progress toward synthesis of polymeric polyradicals
[AD-A223414] N90-29510
Modification of polystyrene/polybutadiene block copolymer films by chemical reaction with bromine and effect on gas permeability
[AD-A223612] N90-29513

POLYURETHANE FOAM
The optimum polymer binder for pressable high performance explosives: A preliminary evaluation
[ETN-90-97612] N90-29524

POPULATION THEORY
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996

POROSITY
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29466
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105

POROUS MATERIALS
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619

POSITION (LOCATION)
PLRS: A new spread spectrum position location reporting system N90-29358
Enhancing PLRS with user-to-user data capability N90-29359
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372
A method of determining a laser-velocimeter focal point and measuring its beam properties using a hot-wire anemometer
[NAL-TR-1043] N90-29626
Use of 3D vision for fine robot motion N90-29804
Controlling multiple manipulators using RIPS N90-29814

POSITION ERRORS
Applications of differential GPS N90-29349
The determination of PDOP (Position Dilution of Precision) in GPS N90-29351
Analysis of the integrity of the Microwave Landing System (MLS) data functions N90-29365
Omega navigation signal characteristics N90-29369
State estimation for systems moving through random fields N90-29373
An integrated system for land navigation N90-29377

POSITION INDICATORS
Enhancing PLRS with user-to-user data capability N90-29359

POSITIONING
Modular digital GPS receivers N90-29346
Applications of differential GPS N90-29349
The determination of PDOP (Position Dilution of Precision) in GPS N90-29351
Enhancing PLRS with user-to-user data capability N90-29359
Analysis of the integrity of the Microwave Landing System (MLS) data functions N90-29365
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies
[AD-A224358] N90-29539
Active vibration damping of flexible structures
[DLR-FB-90-03] N90-29676
Traction-drive force transmission for telerobotic joints N90-29790
Modeling and sensory feedback control for space manipulators N90-29807

POWDER (PARTICLES)
Powder processing of aluminides
[DE90-015314] N90-29447
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520

POWDER METALLURGY
Powder processing of aluminides
[DE90-015314] N90-29447

POWER SPECTRA
Estimation of power spectral density of runway roughness
[NAL-TR-1037] N90-29411

POWERED LIFT AIRCRAFT
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989
[AD-A224256] N90-29299
POYNTING THEOREM
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724
PREBURNERS
Combustion characteristics of oxygen/hydrogen high pressure preburners for staged combustion cycle rocket engine
[NAL-TR-1044] N90-29434
PRECIPITATION (CHEMISTRY)
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098
PRECISION GUIDED PROJECTILES
Integrated strapdown avionics for precision guided vehicles N90-29361
PREDICTION ANALYSIS TECHNIQUES
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
Theoretical investigations of Pi-conjugated polyradicals as models for organic magnetic materials
[AD-A223411] N90-29461
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29684
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704
PREDICTIONS
An investigation of crack-tip stress field criteria for predicting cleavage-crack initiation
[DE90-015597] N90-29672
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
PREFLIGHT ANALYSIS
Shuttle remote manipulator system mission preparation and operations N90-29909
PRESSURE
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
PRESSURE DISTRIBUTION
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033
PRESSURE EFFECTS
Cavity aeroacoustics
[AD-A223853] N90-29307
PRESSURE GRADIENTS
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
PRESSURE MEASUREMENT
Recommended practices for measurement of gas path pressures and temperatures for performance assessment of aircraft turbine engines and components
[AGARD-AR-245] N90-29393
Proceedings of a discussion meeting on Thermodynamics of Alloys
[AD-A224336] N90-29476
Design and evaluation of candidate pressure distribution and air data system tile penetration for the aeroassist flight experiment
[NASA-CR-4312] N90-29615
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619
Non-contact contour gage
[DE90-014672] N90-29642
PRESSURE OSCILLATIONS
Tests of initialization procedures with the NRL limited area numerical weather prediction model
[AD-A223549] N90-29750
PRESSURE SENSORS
Improved meteorological measurements from buoys and ships (IMET): Preliminary report on barometric pressure sensors
[PB90-242116] N90-29748
PRESSURE VESSELS
An investigation of crack-tip stress field criteria for predicting cleavage-crack initiation
[DE90-015597] N90-29672
PRINTED CIRCUITS
CAD models for inductive strips in homogeneous finline: The methodology
[AD-A224448] N90-29564
Using multiple sensors for printed circuit board insertion N90-29867
PROBABILITY DENSITY FUNCTIONS
Effects of parameter uncertainties on software development effort estimates
[AD-A223304] N90-29938
Angle sample variance of azimuthally spread scattering processes, using a two-element array
[AD-A223572] N90-30034
PROBABILITY DISTRIBUTION FUNCTIONS
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934
PROBABILITY THEORY
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
Problems in probability, statistics, and reliability
[AD-A224152] N90-30016
For the definition of two person zero sum games
[ETN-90-97294] N90-30022
Audibility and annoyance of en route noise of unducted fan engines
[AD-A223687] N90-30035
PROBLEM SOLVING
Generic task problem solvers in Soar N90-29904
An efficient temporal logic for robotic task planning N90-29906
Tutorial on using LISP object-oriented programming for blackboards: Solving the radar tracking problem
[AD-A224272] N90-29930
An instability theorem for a certain sixth order differential equation
[DE90-627150] N90-29990
Periodic solutions of certain fifth order differential equations
[DE90-627160] N90-29994
An algebraic hierarchical basis preconditioner
[DE90-015875] N90-30008
Problems in probability, statistics, and reliability
[AD-A224152] N90-30016
PROCEDURES
Recommended practices for measurement of gas path pressures and temperatures for performance assessment of aircraft turbine engines and components
[AGARD-AR-245] N90-29393
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712
PROCESS CONTROL (INDUSTRY)
Processing of polymers using supercritical fluids
[AD-A223681] N90-29514
Planar waveguide spectrometer
[DE90-016308] N90-30057
PRODUCT DEVELOPMENT
Realization of equipment for manufacturing titanium alloy electrodes for first step melting
[ONERA-RT-15/3578-M] N90-29498
PRODUCTION COSTS
Innovative techniques for the production of low cost 2D laser diode arrays
[AD-A223575] N90-29632
High throughput MBE materials for MODFET's
[AD-A223452] N90-30097
PRODUCTIVITY
Total quality management: A recipe for success
[AD-A223287] N90-30122
PROGRAM VERIFICATION (COMPUTERS)
Strategies for tutoring multiple bugs
[AD-A223921] N90-29927
Formal verification of mathematical software, volume 2
[AD-A223633] N90-29943
Formal design and verification of a reliable computing platform for real-time control. Phase 1: Results
[NASA-TM-102716] N90-29965
Assembler for a parallel computer
[NAL-TM-586] N90-29974
Survey of formal specification techniques for reactive systems
[AD-A223741] N90-30005
PROGRAMMING LANGUAGES
THREAD: A programming environment for interactive planning-level robotics applications N90-29810
A VHDL interface for Altera design files
[AD-A224476] N90-29920
System software for Soviet computers N90-29921
Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
Language and system support for concurrent programming
[AD-A223760] N90-29949
Durra: A task-level description language user's manual
[AD-A223761] N90-29950
MacRootLocus: A CAD design tool for feedback control systems
[AD-A223772] N90-29951
Software design for high integrity systems
[ETN-90-97517] N90-29966
PROJECT MANAGEMENT
GPS integrity requirements for use by civil aviation N90-29339
Activities report of the European Space Agency
[ISSN-0258-025X] N90-30169
PROJECTILES
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
SONA: A measurement system for the determination of the end-of-flight burst behaviour of projectiles equipped with proximity fuses
[FEL-89-A293] N90-29536
Detectors and signal processing for the speed measuring system 4-01
[FEL-1989-64] N90-29623
PROJECTS
Activities report of the Institute of Sound and Vibration Research
[ETN-90-97604] N90-30170
PROPAGATION MODES
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29568
PROPELLANT ADDITIVES
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526
PROPELLANT COMBUSTION
AFOSR/ONR Contractors' Meeting on Combustion Rocket Propulsion Diagnostics of Reacting Flow
[AD-A224411] N90-29432
Investigation of fluid dynamic performance of LE-7 liquid oxygen pump
[NAL-TR-1020] N90-29650
PROPELLANT GRAINS
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526
PROPELLANTS
Analysis of scramjet engine characteristics
[NAL-TR-1041] N90-29398
PROPELLER BLADES
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1046] N90-29326
PROPELLERS
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1046] N90-29326
Generalized Advanced Propeller Analysis System (GAPAS). Volume 2: Computer program user manual
[NASA-CR-185277] N90-29394
PROPULSION
Solid fuel combustion chamber
[LR-634] N90-29433
PROPULSION SYSTEM PERFORMANCE
Solid fuel combustion chamber
[LR-634] N90-29433
PROTECTIVE COATINGS
Investigation of laser diagnostics of PACVO (Plasma Assisted Chemical Vapor Deposition) processes for depositing hard face coatings
[DE90-016209] N90-29522
PROTOCOL (COMPUTERS)
High speed bus technology development
[AD-A224486] N90-29565
Working implementation agreements for open systems interconnection protocols
[PB90-197948] N90-30127
PROTONS
A search for low energy cosmic ray antiprotons N90-30161
PROTOTYPES
Issues in expanding the software base management system supporting the Computer Aided Prototyping System (CAPS)
[AD-A224344] N90-29933

PROXIMITY
Space robotic system for proximity operations
N90-29806
PSYCHOLOGICAL FACTORS
Optimism and cardiovascular reactivity to psychological and cold pressor stress
[AD-A223818] N90-29771
Norms and perception of events
[AD-A224236] N90-29774
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133
PSYCHOLOGY
Norms and perception of events
[AD-A224236] N90-29774
PSYCHOMETRICS
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996
PULSARS
Fast pulsars, strange stars: An opportunity in radio astronomy
[DE90-015630] N90-30155
PULSE COMPRESSION
Development of an all solid state 6 kHz pulse generator for driving free electron laser amplifiers
[AD-A224105] N90-29561
PULSE GENERATORS
Development of an all solid state 6 kHz pulse generator for driving free electron laser amplifiers
[AD-A224105] N90-29561
High voltage picosecond pulse generation using avalanche diodes
[DE90-015194] N90-29577
PULSED LASERS
Nondestructive material characterization
[DE90-015176] N90-29652
PULSES
Long pulse diode experiments
[DE90-016218] N90-29578
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system
[DE90-015203] N90-29620
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106
PYROLYSIS
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
PYROTECHNICS
Development and evaluation of hermetic laser diode ignited pyrotechnic components
[DE90-015745] N90-29529
Analysis of pyrotechnic devices by laser-illuminated high speed photography
[DE90-015741] N90-29530
An effective low-profile thermite torch
[DE90-015746] N90-29534
Finite difference modeling of laser diode ignited components
[DE90-015652] N90-29635
PYRROLES
Pyrromethene-BF2 complexes as laser dyes
[AD-A223562] N90-29631

Q

QUALITY CONTROL
Utilization of a measurement process by the examination of universal motors
[ETN-90-97307] N90-29581
Total quality management: A recipe for success
[AD-A223287] N90-30122
QUANTUM EFFICIENCY
Two terminal CuInSe2 based cascade cells
[DE90-000363] N90-29697
QUANTUM ELECTRONICS
Report on the International Workshop on Progress Towards Molecular Scale Electronics
[AD-A223758] N90-29575
Novel approaches to sensitivity enhancement of ring laser gyros
[AD-A224335] N90-29617
QUANTUM MECHANICS
Report on the International Workshop on Progress Towards Molecular Scale Electronics
[AD-A223758] N90-29575
On a calculation of the ground-state energy in quantum mechanics
[DE90-627182] N90-30119
QUANTUM THEORY
Higher order equations of motion
[DE90-627522] N90-30038
On Dirac's conjecture for Hamiltonian systems with first and second class constraints
[DE90-627206] N90-30116
Workshop on Low-Dimensional Quantum Field Theory and its Applications
[DE90-508071] N90-30118
QUANTUM WELLS
Quantum well infrared detectors 1: Some calculations of their optical properties
[RSRE-MEMO-4363] N90-30062
Nonlinear optical studies of the optical and electronic properties of semiconductor heterostructures
[AD-A223408] N90-30096
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
Manufacturing and characterization of liquid-phase epitaxy layers with atomic levels at the crystal surface and at the hetero limit surfaces in the system GaAs-AlGaAs
[ETN-90-97310] N90-30113
QUARKS
Fast pulsars, strange stars: An opportunity in radio astronomy
[DE90-015630] N90-30155
QUERY LANGUAGES
Formal semantics of SQL queries
[REPT-89-069] N90-29973
Accessing network databases via SQL transactions in a multi-model database system
[AD-A223946] N90-30128

R

RADAR
Radar clutter via ray methods
[AD-A223796] N90-29553
RADAR ANTENNAS
Analysis and design of modifications for improved performance of the AFIT radar cross section measurement chamber
[AD-A223352] N90-29545
RADAR APPROACH CONTROL
Study improvement training facilities ground control air traffic controllers. Part 1: Alternative solutions and their consequences
[FEL-89-A257-PT-1] N90-29380
Study improvement training facilities ground control air traffic controllers. Part 2: Functional analysis approach control trainer
[FEL-89-A280-PT-2] N90-29409
RADAR CROSS SECTIONS
Analysis and design of modifications for improved performance of the AFIT radar cross section measurement chamber
[AD-A223352] N90-29545
Bistatic radar cross section of a perfectly conducting rhombus-shaped flat plate
[AD-A223418] N90-29546
High range resolution radar cross-section profiles: A preliminary analysis
[AD-A223448] N90-29550
RADAR NAVIGATION
Survivable penetration N90-29363
An Ada-based marine radar simulator for collision avoidance training
[ETN-90-97611] N90-29970
RADAR RECEIVERS
Radar receiver procedures
[AD-A224399] N90-29541
RADAR TRACKING
Tutorial on using LISP object-oriented programming for blackboards: Solving the radar tracking problem
[AD-A224272] N90-29930
RADAR TRANSMISSION
Neural networks and radar systems
[FEL-89-B65] N90-29558
RADIANT FLUX DENSITY
Some studies related to a new Hexagonal Compound Parabolic Concentrator (HCPC) as a secondary in tandem with a solar tower
[DLR-FB-90-12] N90-29700
RADIATION ABSORPTION
Laser beam stop
[AD-D014595] N90-29629
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
RADIATION BELTS
NASA radiation belt models AP-8 and AE-8
[AD-A223660] N90-29737
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166
RADIATION COUNTERS
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/06] N90-30164
RADIATION DAMAGE
Accurate calculations of neutron kerma and damage from ENDF/B-VI evaluations for silicon, chromium, iron and nickel, and comparison with ENDF/B-V results
[DE90-016020] N90-29674
An advanced single event upset tester
[AD-A223613] N90-30163
RADIATION DOSAGE
A tandem system of ionization chambers for effective energy determination of unknown X-radiation fields
[DE90-630463] N90-29405
RADIATION EFFECTS
Swelling of neutron irradiated vanadium alloys
[DE90-015294] N90-29472
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108
RADIATION MEASUREMENT
Establishment of a capability to measure optical transition radiation
[AD-A224094] N90-30047
An advanced single event upset tester
[AD-A223613] N90-30163
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166
RADIATION MEASURING INSTRUMENTS
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
RADIATIVE HEAT TRANSFER
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300
RADIATIVE TRANSFER
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29728
RADICALS
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers
[AD-A223409] N90-29509
RADIO ASTRONOMY
Fast pulsars, strange stars: An opportunity in radio astronomy
[DE90-015630] N90-30155
RADIO COMMUNICATION
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730
RADIO FREQUENCIES
Modular digital GPS receivers N90-29346
RADIO FREQUENCY INTERFERENCE
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A224392] N90-29725
RADIO TRANSMISSION
The effects on antenna-filtered scintillation parameters of non-zero antenna pointing angles
[AD-A223840] N90-29554
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
RADIO WAVES
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves
[AD-A223685] N90-29738

RADIOACTIVE DECAY
Electronic and photonic power applications
[DE90-015567] N90-29698
RADIOMETERS
Characteristics of pushbroom scanning type radiometer utilizing linear sensors
[NAL-TR-1024] N90-29625
RAILGUN ACCELERATORS
Application of a rechargeable, small caliber railgun power supply
[AD-A224207] N90-29418
RAMAN SPECTRA
Feasibility of the temperature measurements in hypersonic flow by multibeam coherent Raman anti-Stokes scattering
[ONERA-RF-56/7131-PY] N90-29312
CARS spectroscopy and applications N90-29321
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
RAMAN SPECTROSCOPY
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
RAMJET ENGINES
Solid fuel combustion chamber
[LR-634] N90-29433
RANDOM SAMPLING
On the stability of robotic systems with random communication rates N90-29865
RANDOM VARIABLES
Effects of parameter uncertainties on software development effort estimates
[AD-A223304] N90-29938
RANGE FINDERS
Observability of relative navigation using range-only measurements N90-29360
RANGEFINDING
Techniques for autonomous GPS integrity monitoring N90-29345
The determination of PDOP (Position Dilution of Precision) in GPS N90-29351
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
RANKINE CYCLE
The nuclear battery
[DE90-630400] N90-29559
RANKING
Establishing viable task domains for telerobot demonstrations N90-29886
RARE GASES
An electron spin resonance study of adsorbed gases in ultrahigh vacuum
[ETN-90-97323] N90-29489
RAREFIED GAS DYNAMICS
Electron beam for velocity determination N90-29319
RATES (PER TIME)
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
RAY TRACING
High power oblique incidence HF ionospheric modification
[AD-A224402] N90-29729
Regional phase propagation in three dimensionally heterogeneous media
[AD-A223279] N90-29731
Ray traced scalar fields with shaded polygonal output
[DE90-011023] N90-29955
REACTION KINETICS
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
Transition metal activation and functionalization of carbon-hydrogen bonds
[DE90-015826] N90-29489
Kinetics and structure of silicate sol-gels
[DE90-015702] N90-29521
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695
Synthesis and property evaluation of Y-Ba2-Cu3-O(8+x) superconductors
[AD-A223494] N90-30098
REACTOR MATERIALS
Accurate calculations of neutron kerma and damage from ENDF/B-VI evaluations for silicon, chromium, iron and nickel, and comparison with ENDF/B-V results
[DE90-016020] N90-29674
REAL TIME OPERATION
Distributed control architecture for CNI preprocessors N90-29356
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
A land navigation demonstration vehicle with a color map display for tactical use N90-29375
Inertial navigation system simulator program: Top-level design
[AD-A223762] N90-29379
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
Integrated controls and health monitoring fiberoptic shaft monitor
[NASA-CR-185210] N90-29622
Concept for a reference model Architecture for Real-Time Intelligent Control Systems (ARTICS)
[PB90-220286] N90-29638
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
Experiments in cooperative manipulation: A system perspective N90-29812
Controlling multiple manipulators using RIPS N90-29814
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Performance constraints and compensation for teleoperation with delay N90-29881
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
The indexed time table approach for planning and acting N90-29907
Realtime multi-plot graphics system
[NASA-CR-4304] N90-29919
Formal design and verification of a reliable computing platform for real-time control. Phase 1: Results
[NASA-TM-102716] N90-29965
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
Submicron particle analyzer
[AD-A223558] N90-30050
A compact real-time acousto-optic image correlator
[DE90-015564] N90-30054
RECEIVERS
Modular digital GPS receivers N90-29346
RECOGNITION
Automatic recognition of tractability in inference relations
[AD-A223698] N90-30003
RECORDING
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
A review of manganin gauge technology for measurements in the gigapascal range
[MRL-TR-90-5] N90-30026
Comparison of electro-optic diagnostic systems
[DE90-015619] N90-30056
RECORDING INSTRUMENTS
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722
RECRYSTALLIZATION
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
RECTANGULAR WAVEGUIDES
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29568
RECURSIVE FUNCTIONS
Recursive multibody dynamics and discrete-time optimal control N90-29860
Recursive Newton-Euler formulation of manipulator dynamics N90-29862
REDUCED GRAVITY
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
Renal response to seven days of lower body positive pressure in the squirrel monkey
[NASA-CR-183355] N90-29761
Experimental study on two-dimensional free-flying robot satellite model N90-29896
REDUCTION (CHEMISTRY)
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29486
Chemical stabilization of laser dyes
[AD-A224219] N90-29627
REDUNDANCY
A single wafer bit-sliced convolver: An optimum statistical solution for the implementation of redundancy
[REPT-89-019] N90-29584
Techniques for developing a system safety risk assessment model
[AD-A223477] N90-29654
Redundant sensorized arm+hand system for space telerobotized manipulation N90-29792
Redundancy of space manipulator on free-flying vehicle and its nonholonomic path planning N90-29797
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870
Comparison of joint space versus task force load distribution optimization for a multiarm manipulator system N90-29873
REDUNDANCY ENCODING
Short encodings of evolving structures
[AD-A223641] N90-29944
REENTRY VEHICLES
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300
REFLECTANCE
Thermal imaging assessment
[AD-A224400] N90-29542
Two terminal CuInSe2 based cascade cells
[DE90-000363] N90-29697
Effect of retardation on the reflectance properties of the metallic Fibonacci quasi-superlattice
[DE90-627316] N90-30091
REFLECTORS
An x ray source for lithography
[AD-D014596] N90-29630
REFRACTED WAVES
Image amplification in photoreactive crystals and utilization in optical reaction systems
[ETN-90-97285] N90-30059
REFRACTION
Characteristics of pushbroom scanning type radiometer utilizing linear sensors
[NAL-TR-1024] N90-29625
REFRACTORY MATERIALS
Processability and high temperature behavior of emerging aerospace alloys
[AD-A224285] N90-29475
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480
REGRESSION ANALYSIS
Trend analysis of total ozone data N90-29703
REGULATIONS
Tests for aircraft interior materials in fire accident
[LR-622] N90-29337
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706
REINFORCING FIBERS
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming
[LR-621] N90-29451
REINFORCING MATERIALS
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
RELATIVITY
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
A new vector-tensor theory and higher-dimensional cosmology
[DE90-507990] N90-30117
Information loss down a black hole
[DE90-627482] N90-30154
RELIABILITY
Reliability and performance of friction measuring tires and friction equipment correlation
[AD-A223694] N90-29408
Systems reliability and inference: Summary of accomplishments 1988-1990
[AD-A224433] N90-29653
Performance monitoring, fault detection, fault localization design guidance
[AD-A223619] N90-29655
External information sources and aerospace R/D: The use and importance of technical reports by US Aerospace engineers and scientists
[NASA-TM-101232] N90-30132
RELIABILITY ANALYSIS
Formal design and verification of a reliable computing platform for real-time control. Phase 1: Results
[NASA-TM-102716] N90-29965

RELIABILITY ENGINEERING
Development of an all solid state 6 kHz pulse generator for driving free electron laser amplifiers [AD-A224105] N90-29561
VLSI design for reliability [AD-A224264] N90-29562
Analysis and synthesis of robust data structures [AD-A224568] N90-30131
REMOTE CONTROL
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794
Robotic tele-existence N90-29796
Telepresence system development for application to the control of remote robotic systems N90-29799
The 3D model control of image processing N90-29800
Control strategies for a telerobot N90-29808
Autonomous sensor-based dual-arm satellite grappling N90-29809
A design strategy for autonomous systems N90-29818
Learning in tele-autonomous systems using Soar N90-29819
Design of a structural and functional hierarchy for planning and control of telerobotic systems N90-29820
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Global models: Robot sensing, control, and sensory-motor skills N90-29849
The laboratory telerobotic manipulator program N90-29869
System architectures for telerobotic research N90-29872
Performance constraints and compensation for teleoperation with delay N90-29881
Flight telerobotic servicer control from the Orbiter N90-29882
Teleoperation experiments with a Utah/MIT hand and a VPL DataGlove N90-29883
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
The astronaut and the banana peel: An EVA retriever scenario N90-29897
Next generation space robot N90-29899
REMOTE MANIPULATOR SYSTEM
A fast 3-D object recognition algorithm for the vision system of a special-purpose dexterous manipulator N90-29803
Control strategies for a telerobot N90-29808
Optimal payload rate limit algorithm for zero-G manipulators N90-29858
Preshaping command inputs to reduce telerobotic system oscillations N90-29880
Shuttle remote manipulator system mission preparation and operations N90-29909
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
Dexterous manipulator flight demonstration N90-29911
REMOTE SENSING
Non-contact contour gage [DE90-014672] N90-29642
The skin temperature of mountain slopes and the determination of the sensible heat flux [DLR-FB-90-07] N90-29754
REMOTE SENSORS
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
A global approach to image texture analysis [AD-A223532] N90-29941
REMOTELY PILOTED VEHICLES
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform [NASA-CR-186226] N90-29381
RENAL FUNCTION
Renal response to seven days of lower body positive pressure in the squirrel monkey [NASA-CR-183355] N90-29761
REPORTS
Activities report of the Institute of Sound and Vibration Research [ETN-90-97604] N90-30170
REQUIREMENTS
Survey of formal specification techniques for reactive systems [AD-A223741] N90-30005
RESEARCH AIRCRAFT
Procedure for calibrating fly-by-wire control chains of the flying testbed ATTAS [DLR-MITT-90-02] N90-29401
The signals of an ice warning device in dependence on total water content and normalized icing degree [ESA-TT-1207] N90-29692
RESEARCH AND DEVELOPMENT
JPRS report: Science and technology. USSR: Earth sciences [JPRS-UES-90-004] N90-29688
JPRS report: Science and technology. USSR: Earth sciences [JPRS-UES-90-003] N90-29689
JPRS Report: Science and technology. USSR: Life sciences [JPRS-ULS-90-007] N90-29762
JPRS report: Science and technology. USSR: Life sciences [JPRS-ULS-90-004] N90-29763
Telerobotic activities at Johnson Space Center N90-29875
NASA authorization, 1991, volume 2 [GPO-32-196] N90-30138
Activities report of the Space Science Department [ESA-SP-1126] N90-30142
Activities report of the European Space Agency [ISSN-0258-025X] N90-30169
Activities report of the Institute of Sound and Vibration Research [ETN-90-97604] N90-30170
RESIDUAL STRESS
High performance brittle matrices and brittle matrix composites, book 2 [AD-A223274] N90-29441
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite [AD-A223696] N90-29445
RESIN MATRIX COMPOSITES
Thermal analysis of bismaleimide matrix resins [DE90-016283] N90-29523
RESISTANCE HEATING
Thermal analyses of power subsystem components [NASA-CR-186314] N90-29637
RESONANCE
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
Adiabatic invariance and transient resonance in very slowly varying oscillatory Hamiltonian systems [DE90-016118] N90-30007
Medium energy nuclear physics research [DE90-015852] N90-30042
RESONANT FREQUENCIES
A vector diagram approach to shaping inputs for vibration reduction [AD-A223724] N90-29671
Investigation of a heat driven thermoacoustic prime mover [AD-A223928] N90-29694
RESOURCES MANAGEMENT
Global Climate Change: Seeking a Global Consensus [S-HRG-101-842] N90-29704
Effects of increased CO2 on forest response [DE90-015406] N90-29708
The technology transfer process: Background for the national energy strategy [DE90-015301] N90-30139
RETIREMENT FOR CAUSE
Assessment and improvement of aeroengine disc structural integrity N90-29392
REUSE
The effect of software reusability on information theory based software metrics [AD-A224472] N90-29936
REVERBERATION
Angle sample variance of azimuthally spread scattering processes, using a two-element array [AD-A223572] N90-30034
RHEOLOGY
Rheology of filler rubber: Silica-silicone [AD-A223600] N90-29511
Effect of particulate fillers on the rheology of polymer melts [AD-A223601] N90-29512
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11 [AD-A223431] N90-29664
RHOMBOIDS
Bistatic radar cross section of a perfectly conducting rhombus-shaped flat plate [AD-A223418] N90-29546
RICCATI EQUATION
On equations of motion on complex Grassman manifold [DE90-628369] N90-29999
RIGID STRUCTURES
How to push a block along a wall N90-29848
RING LASERS
Ring laser gyro principles and techniques N90-29352
Use of a three-axis monolithic ring laser gyro and digital signal processor in an inertial sensor element N90-29354
Ring laser gyro marine inertial navigation systems N90-29355
Novel approaches to sensitivity enhancement of ring laser gyros [AD-A224335] N90-29617
RINGS
Hyperbolic Hjelmslev groups [ETN-90-97298] N90-30009
RISK
Techniques for developing a system safety risk assessment model [AD-A223477] N90-29654
Preliminary hazard analysis in design application to EVA space suit [ETN-90-97585] N90-29918
For the definition of two person zero sum games [ETN-90-97294] N90-30022
ROBOT ARMS
Modeling, design, and control of flexible manipulator arms: Status and trends N90-29782
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
Technology and task parameters relating to the effectiveness of the bracing strategy N90-29785
Manipulators with flexible links: A simple model and experiments N90-29786
Experiments in identification and control of flexible-link manipulators N90-29787
Autonomous dexterous end-effectors for space robotics N90-29788
Design and control of a multi-fingered robot hand provided with tactile feedback N90-29789
Force/torque and tactile sensors for sensor-based manipulator control N90-29791
Telepresence system development for application to the control of remote robotic systems N90-29799
The 3D model control of image processing N90-29800
Use of 3D vision for fine robot motion N90-29804
Control strategies for a telerobot N90-29808
Autonomous sensor-based dual-arm satellite grappling N90-29809
Stability analysis of multiple-robot control systems N90-29811
Time optimal movement of cooperating robots N90-29815
Learning in tele-autonomous systems using Soar N90-29819
Design of a structural and functional hierarchy for planning and control of telerobotic systems N90-29820
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
Test and validation for robot arm control dynamics simulation N90-29826
Graphic overlays in high-precision teleoperation: Current and future work at JPL N90-29827
Proceedings of the NASA Conference on Space Telerobotics, volume 4 [NASA-CR-186859] N90-29830
An improved adaptive control for repetitive motion of robots N90-29831
Model based manipulator control N90-29833
A discrete decentralized variable structure robotic controller N90-29835
The JAU-JPL anthropomorphic telerobot N90-29838
A procedure concept for local reflex control of grasping N90-29839
Sensor-based fine telemanipulation for space robotics N90-29841
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
The effects of gear reduction on robot dynamics N90-29861
Recursive Newton-Euler formulation of manipulator dynamics N90-29862
Kinematic sensitivity of robot manipulators N90-29863
The laboratory telerobotic manipulator program N90-29869
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870
The control of space manipulators subject to spacecraft attitude control saturation limits N90-29871

Comparison of joint space versus task force load distribution optimization for a multiarm manipulator system N90-29873
Proceedings of the NASA Conference on Space Telerobotics, volume 5 [NASA-CR-186860] N90-29874
Application of recursive manipulator dynamics to hybrid software/hardware simulation N90-29876
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877
Inverse dynamics of a 3 degree of freedom spatial flexible manipulator N90-29878
A control approach for robots with flexible links and rigid end-effectors N90-29879
Teleoperation experiments with a Utah/MIT hand and a VPL DataGlove N90-29883
Integration of a sensor based multiple robot environment for space applications: The Johnson Space Center Teleoperator Branch Robotics Laboratory N90-29890
On discrete control of nonlinear systems with applications to robotics N90-29893
Flight experiments in telerobotics-Orbiter middeck concept N90-29895
Experimental study on two-dimensional free-flying robot satellite model N90-29896
Computed torque control of a free-flying cooperating-arm robot N90-29898
Computer simulation and design of a three degree-of-freedom shoulder module N90-29902
A collision avoidance system for a spaceplane manipulator arm N90-29903

ROBOT DYNAMICS
Technology and task parameters relating to the effectiveness of the bracing strategy N90-29785
Autonomous dexterous end-effectors for space robotics N90-29788
Redundant sensorized arm+hand system for space telerobotized manipulation N90-29792
Impedance hand controllers for increasing efficiency in teleoperations N90-29793
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794
Redundancy of space manipulator on free-flying vehicle and its nonholonomic path planning N90-29797
Guidance algorithms for a free-flying space robot N90-29798
Use of 3D vision for fine robot motion N90-29804
An improved adaptive control for repetitive motion of robots N90-29831
Direct adaptive control of a PUMA 560 industrial robot N90-29832
Model based manipulator control N90-29833
Discrete-time adaptive control of robot manipulators N90-29834
A discrete decentralized variable structure robotic controller N90-29835
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
Response to reflected-force feedback to fingers in teleoperations N90-29837
The JAU-JPL anthropomorphic telerobot N90-29838
A procedure concept for local reflex control of grasping N90-29839
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
Sensor-based fine telemanipulation for space robotics N90-29841
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
How to push a block along a wall N90-29848
Linear analysis of a force reflective teleoperator N90-29856
Recursive multibody dynamics and discrete-time optimal control N90-29860
The effects of gear reduction on robot dynamics N90-29861
Recursive Newton-Euler formulation of manipulator dynamics N90-29862
Kinematic sensitivity of robot manipulators N90-29863
Efficient conjugate gradient algorithms for computation of the manipulator forward dynamics N90-29864
Determining robot actions for tasks requiring sensor interaction N90-29868
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870
The control of space manipulators subject to spacecraft attitude control saturation limits N90-29871
Application of recursive manipulator dynamics to hybrid software/hardware simulation N90-29876
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877
Inverse dynamics of a 3 degree of freedom spatial flexible manipulator N90-29878
A control approach for robots with flexible links and rigid end-effectors N90-29879
Teleoperation experiments with a Utah/MIT hand and a VPL DataGlove N90-29883
An alternative control structure for telerobotics N90-29889
On discrete control of nonlinear systems with applications to robotics N90-29893
A spatial operator algebra for manipulator modeling and control N90-29894
Flight experiments in telerobotics-Orbiter middeck concept N90-29895
Experimental study on two-dimensional free-flying robot satellite model N90-29896
The astronaut and the banana peel: An EVA retriever scenario N90-29897
Computed torque control of a free-flying cooperating-arm robot N90-29898
Computer simulation and design of a three degree-of-freedom shoulder module N90-29902
Dexterous manipulator flight demonstration N90-29911
An intelligent, free-flying robot N90-29912

ROBOT SENSORS
Force/torque and tactile sensors for sensor-based manipulator control N90-29791
A procedure concept for local reflex control of grasping N90-29839
Sensor-based fine telemanipulation for space robotics N90-29841
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Information management in an integrated space telerobot N90-29846
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
The 3-D vision system integrated dexterous hand N90-29850
RCTS: A flexible environment for sensor integration and control of robot systems; the distributed processing approach N90-29852
Using multiple sensors for printed circuit board insertion N90-29867
Determining robot actions for tasks requiring sensor interaction N90-29868
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870
System architectures for telerobotic research N90-29872
Integration of a sensor based multiple robot environment for space applications: The Johnson Space Center Teleoperator Branch Robotics Laboratory N90-29890
Dexterous manipulator flight demonstration N90-29911

ROBOTICS
Concept for a reference model Architecture for Real-Time Intelligent Control Systems (ARTICS) [PB90-220286] N90-29638
Robots, systems, and flexible automation [DE90-015802] N90-29649
Proceedings of the NASA Conference on Space Telerobotics, volume 3 [NASA-CR-186858] N90-29780
The flight telerobotic servicer: NASA's first operational space robot N90-29781
Modeling, design, and control of flexible manipulator arms: Status and trends N90-29782
Capture of free-flying payloads with flexible space manipulators N90-29784
Traction-drive force transmission for telerobotic joints N90-29790
An advanced telerobotic system for shuttle payload changeout room processing applications N90-29795
Robotic tele-existence N90-29796
Telepresence system development for application to the control of remote robotic systems N90-29799
The 3D model control of image processing N90-29800
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
Telerobotic workstation design aid N90-29805
Space robotic system for proximity operations N90-29806
THREAD: A programming environment for interactive planning-level robotics applications N90-29810
Experiments in cooperative manipulation: A system perspective N90-29812
Controlling multiple manipulators using RIPS N90-29814
Design of a structural and functional hierarchy for planning and control of telerobotic systems N90-29820
The flight telerobotic servicer project: A technical overview N90-29821
The flight telerobotic servicer Tinman concept: System design drivers and task analysis N90-29822
The flight telerobotic servicer: From functional architecture to computer architecture N90-29823
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
The Goddard Space Flight Center (GSFC) robotics technology testbed N90-29825
Use of graphics in decision aids for telerobotic control: (Parts 5-8 of an 8-part MIT progress report) N90-29829
Proceedings of the NASA Conference on Space Telerobotics, volume 4 [NASA-CR-186859] N90-29830
Global models: Robot sensing, control, and sensory-motor skills N90-29849
A layered abduction model of perception: Integrating bottom-up and top-down processing in a multi-sense agent N90-29851
Vehicle path-planning in three dimensions using optics analogs for optimizing visibility and energy cost N90-29853
Vacuum mechatronics N90-29854
Uniform task level definitions for robotic system performance comparisons N90-29855
On the stability of robotic systems with random communication rates N90-29865
Precedence relationship representations of mechanical assembly sequences N90-29866
Proceedings of the NASA Conference on Space Telerobotics, volume 5 [NASA-CR-186860] N90-29874
Telerobotic activities at Johnson Space Center N90-29875
Integration of a sensor based multiple robot environment for space applications: The Johnson Space Center Teleoperator Branch Robotics Laboratory N90-29890
An efficient temporal logic for robotic task planning N90-29906
Approach to telerobot computing architecture [NASA-CR-186993] N90-29984

ROBOTS
Robots, systems, and flexible automation [DE90-015802] N90-29649
Technology and task parameters relating to the effectiveness of the bracing strategy N90-29785
Modeling and sensory feedback control for space manipulators N90-29807
On the manipulability of dual cooperative robots N90-29813
A design strategy for autonomous systems N90-29818
Direct adaptive control of a PUMA 560 industrial robot N90-29832
RCTS: A flexible environment for sensor integration and control of robot systems; the distributed processing approach N90-29852
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Assembly of objects with not fully predefined shapes N90-29859
Using multiple sensors for printed circuit board insertion N90-29867
Instruction dialogues: Teaching new skills to a robot N90-29884
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
Establishing viable task domains for telerobot demonstrations N90-29886
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29891
Next generation space robot N90-29899
The indexed time table approach for planning and acting N90-29907
Approach to telerobot computing architecture [NASA-CR-186993] N90-29984

ROBUSTNESS (MATHEMATICS)
Robust design of LQG controllers N90-29839
Analysis and synthesis of robust data structures [AD-A224568] N90-30131

ROCKET ENGINES
A planar rocket motor model for visualization of violent reaction due to fragment impact [AD-A224273] N90-29431
Combustion characteristics of oxygen/hydrogen high pressure preburners for staged combustion cycle rocket engine [NAL-TR-1044] N90-29434

Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
RODS
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap
[NAL-TR-1047] N90-29686
ROLL FORMING
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
ROTARY WING AIRCRAFT
The Second ARO Workshop on Rotorcraft Interactional Aerodynamics
[AD-A223310] N90-29304
ROTARY WINGS
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
ROTOR BLADES (TURBOMACHINERY)
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
Investigation of fluid dynamic performance of LE-7 liquid oxygen pump
[NAL-TR-1020] N90-29650
ROTOR DYNAMICS
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
ROTORS
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
RUBBER
Toughening of SAN copolymers by an SAN emulsion grafted rubber
[AD-A224213] N90-29502
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
RUNWAYS
The potential for an extra runway at Heathrow: A preliminary feasibility study
[TT-9007] N90-29403
Estimation of power spectral density of runway roughness
[NAL-TR-1037] N90-29411
AutoPAVER: A software package for automated pavement evaluation
[AD-A224176] N90-29531

S

SAFETY
The nuclear battery
[DE90-630400] N90-29559
SAFETY FACTORS
Preliminary hazard analysis in design application to EVA space suit
[ETN-90-97585] N90-29918
SAFETY MANAGEMENT
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770
Preliminary hazard analysis in design application to EVA space suit
[ETN-90-97585] N90-29918
SAGNAC EFFECT
Ring laser gyro principles and techniques N90-29352
SAMPLED DATA SYSTEMS
On the stability of robotic systems with random communication rates N90-29865
SAMPLING
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-208588] N90-29701
The Surface Air Sampling Program
[DE90-014873] N90-29711
Trapezoidal stratified Monte Carlo integration
[AD-A223565] N90-30021
SANDWICH STRUCTURES
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates
[AD-A223451] N90-29442
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
SAPPHIRE
Special purpose spatial light modulators
[AD-A223794] N90-30052
SATELLITE ATTITUDE CONTROL
A three axis attitude control of a satellite
[NASDA-TR-22] N90-29421
SATELLITE COMMUNICATION
Satellite Constellation Orbit Evaluation (SCORE) program
[AD-A223531] N90-29417
Jamming performance of frequency-hopped communication systems with nonuniform hopping distributions
[AD-A223419] N90-29547
SATELLITE IMAGERY
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691
SATELLITE NAVIGATION SYSTEMS
The 2-D and 3-D characterizations of GPS navigation service N90-29348
Satellite navigation systems for land vehicles N90-29376
SATELLITE OBSERVATION
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724
SATELLITE ORBITS
Satellite Constellation Orbit Evaluation (SCORE) program
[AD-A223531] N90-29417
Satellite motion in an axi-symmetric gravitational field. Part 1: Perturbations due to J2 (second order) and J3
[RAE-TR-88068] N90-29429
SATELLITE TRACKING
Integration of GPS and strapdown inertial subsystems into a single unit N90-29340
SCALARS
Ray traced scalar fields with shaded polygonal output
[DE90-011023] N90-29955
SCALE EFFECT
Terrain visual cue analysis for simulating low-level flight: A multidimensional scaling approach
[AD-A223564] N90-29407
Scale effects in steady-state friction
[DE90-012943] N90-29647
SCANNING TUNNELING MICROSCOPY
Kinetic pathway in Stranski-Krastanov growth of Ge on Si(001)
[AD-A224324] N90-29456
Scanning tunneling microscopy studies of chemisorbed layers on metal surfaces
[DE90-015623] N90-29486
Microscopic aspects of the initial stages of epitaxial growth. A scanning tunneling microscopy study
[AD-A224325] N90-30094
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095
SCATTERING
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
Radar clutter via ray methods
[AD-A223796] N90-29553
Theoretical and experimental comparison of infrared and visible laser scattering from a variety of surface types
[RSRE-MEMO-4348] N90-29636
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
SCATTERING FUNCTIONS
Angle sample variance of azimuthally spread scattering processes, using a two-element array
[AD-A223572] N90-30034
SCENE ANALYSIS
Terrain visual cue analysis for simulating low-level flight: A multidimensional scaling approach
[AD-A223564] N90-29407
Direct estimation of structure and motion from multiple frames
[AD-A223903] N90-29985
SCHEDULING
Inertial navigation system simulator program: Top-level design
[AD-A223762] N90-29379
A new momentum management controller for the space station
[NASA-CR-187265] N90-29425
Reflections on the relationship between artificial intelligence and operations research N90-29816
SCHLIEREN PHOTOGRAPHY
Cavity aeroacoustics
[AD-A223853] N90-29307
SCINTILLATION
The effects on antenna-filtered scintillation parameters of non-zero antenna pointing angles
[AD-A223840] N90-29554
Ionospheric irregularities: Source, structure, plasma processes and effects on sensor systems
[AD-A223908] N90-29723
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730
SCINTILLATION COUNTERS
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A224392] N90-29725
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164
SEA ICE
A global approach to image texture analysis
[AD-A223532] N90-29941
SEALS (STOPPERS)
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
SEARCHING
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775
Unique binary search tree representations and equality-testing of sets and sequences
[AD-A223643] N90-30002
Textual regularities applicable to full text searching: The case of family history literature N90-30125
SEATS
A human factors engineering approach to the development and dynamic evaluation of a prototype aircrew seat for military aircraft
[AD-A218283] N90-29779
SECONDARY EMISSION
Pulsed field sample neutralization
[DE90-015131] N90-29452
SECONDARY FLOW
Secondary flow in presence of wall jets: Incorporation of compression effects in a quasi-elliptic Navier-Stokes calculation code
[ETN-90-97559] N90-29602
SEDIMENTS
Production of jet fuels from coal-derived liquids. Volume 13: Evaluation of storage and thermal stability of jet fuels derived from coal liquids
[AD-A224576] N90-29527
SEISMIC ENERGY
Regional phase propagation in three dimensionally heterogeneous media
[AD-A223279] N90-29731
SEISMIC WAVES
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
Regional phase propagation in three dimensionally heterogeneous media
[AD-A223279] N90-29731
Elastic interfaces
[REPT-90-003] N90-29742
SEISMOLOGY
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722
SEMANTICS
Formal semantics of SQL queries
[REPT-89-069] N90-29973
SEMICIRCULAR CANALS
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767
SEMICONDUCTOR DEVICES
Electronic and photonic power applications
[DE90-015567] N90-29698
SEMICONDUCTOR DIODES
Evaluation of a potential Wave Division Multiplexer (WDM) for use in the IRSTD
[AD-A223945] N90-29560
Innovative techniques for the production of low cost 2D laser diode arrays
[AD-A223575] N90-29632
SEMICONDUCTOR LASERS
Development and evaluation of hermetic laser diode ignited pyrotechnic components
[DE90-015745] N90-29529
Innovative techniques for the production of low cost 2D laser diode arrays
[AD-A223575] N90-29632

Finite difference modeling of laser diode ignited components
[DE90-015652] N90-29635
Comparison of electro-optic diagnostic systems
[DE90-015619] N90-30056

SEMICONDUCTORS (MATERIALS)
New real space correlated-basis-functions approach for the electron correlations of the semiconductor inversion layer
[DE90-627315] N90-30090
Effect of retardation on the reflectance properties of the metallic Fibonacci quasi-superlattice
[DE90-627316] N90-30091
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095
Nonlinear optical studies of the optical and electronic properties of semiconductor heterostructures
[AD-A223408] N90-30096
The II-VI semiconductor superlattices
[AD-A223748] N90-30101

SENSITIVITY
Kinematic sensitivity of robot manipulators N90-29663

SENSORY FEEDBACK
Robotic tele-existence N90-29796
Modeling and sensory feedback control for space manipulators N90-29807

SENSORY PERCEPTION
The 3D model control of image processing N90-29800

SEPARATED FLOW
A numerical study of the response of the laminar unsteady separated flow about a circular cylinder to changes of boundary conditions
[DLR-FB-90-10] N90-29613

SEQUENCING
Precedence relationship representations of mechanical assembly sequences N90-29866
Handbook of data compression algorithms
[ESA-TM-06] N90-29969
Unique binary search tree representations and equality-testing of sets and sequences
[AD-A223643] N90-30002

SERVOCONTROL
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399

SERVOMECHANISMS
Application of recursive manipulator dynamics to hybrid software/hardware simulation N90-29876
A control approach for robots with flexible links and rigid end-effectors N90-29879

SHAFTS (MACHINE ELEMENTS)
Integrated controls and health monitoring fiberoptic shaft monitor
[NASA-CR-185210] N90-29622

SHAPES
Tokamak plasma shape identification with a Legendre-Fourier expansion of the vacuum poloidal flux function in the toroidal coordinates
[DE90-508031] N90-30068

SHEAR FLOW
Cavity aeroacoustics
[AD-A223853] N90-29307
Particle dispersion in a turbulent shear flow
[AD-A224327] N90-29590

SHEAR LAYERS
Numerical simulation supersonic free shear layers
[AD-A223771] N90-29306
Cavity aeroacoustics
[AD-A223853] N90-29307
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587

SHEAR PROPERTIES
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming
[LR-621] N90-29451
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663

SHEAR STRESS
Spectral measurements of the wall shear stress and wall pressure in a turbulent boundary layer: Theory
[AD-A224070] N90-29586
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663

SHELL STABILITY
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
Recent developments in shell stability analysis
[LR-633] N90-29685

SHELLS (STRUCTURAL FORMS)
Recent developments in shell stability analysis
[LR-633] N90-29685

SHOCK WAVES
Theoretical study of the interaction between an oblique shock wave and a turbulent boundary layer from a heated wall
[ONERA-RSF-87/7078/AY-100-A] N90-29313

SHORT WAVE RADIATION
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interactions
[AD-A224282] N90-30065

SIDEBANDS
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720

SIDELOBES
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953

SIGNAL DETECTION
A compact real-time acousto-optic image correlator
[DE90-015564] N90-30054

SIGNAL DISTORTION
Investigation of a heat driven thermoacoustic prime mover
[AD-A223928] N90-29694

SIGNAL PROCESSING
Modular digital GPS receivers N90-29346
The determination of PDOP (Position Dilution of Precision) in GPS N90-29351
Use of a three-axis monolithic ring laser gyro and digital signal processor in an inertial sensor element N90-29354
Distributed control architecture for CNI preprocessors N90-29356
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
Overview of Omega signal coverage N90-29368
Satellite navigation systems for land vehicles N90-29376
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
[AD-A224239] N90-29538
Neural networks and radar systems
[FEL-89-B65] N90-29558
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
Detectors and signal processing for the speed measuring system 4-01
[FEL-1989-84] N90-29623
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735
A comparison of hardware implementations for low-level vision algorithms
[AD-A223699] N90-29945
Adaptive, robust, high-resolution signal processing
[AD-A223728] N90-30004
A review of manganin gauge technology for measurements in the gigapascal range
[MRL-TR-90-5] N90-30026
Optical signal computing
[AD-A223624] N90-30051

SIGNAL TO NOISE RATIOS
High power oblique incidence HF ionospheric modification
[AD-A224402] N90-29729

SIGNAL TRANSMISSION
Overview of Omega signal coverage N90-29368
Omega navigation signal characteristics N90-29369
Graphic overlays in high-precision teleoperation: Current and future work at JPL N90-29827

SILICATES
Kinetics and structure of silicate sol-gels
[DE90-015702] N90-29521

SILICIDES
Alloy design of ordered intermetallics
[DE90-016031] N90-29490

SILICON
Kinetic pathway in Stranski-Krastanov growth of Ge on Si(001)
[AD-A224324] N90-29456
Microscopic aspects of the initial stages of epitaxial growth. A scanning tunneling microscopy study
[AD-A224325] N90-30094
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100

SILICON CARBIDES
The friction and wear of lubricated Si3N4/SiC(w) composites
[DE90-015790] N90-29448
Microstructure of alpha-Al base matrix/SiC particulate composites
[DE90-014894] N90-29449
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450

SILICON COMPOUNDS
Thermochemical data for silicon-containing species from ab initio electronic structure calculations
[DE90-011024] N90-29463

SILICON CONTROLLED RECTIFIERS
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100

SILICON DIOXIDE
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
Effect of particulate fillers on the rheology of polymer melts
[AD-A223601] N90-29512

SILICON NITRIDES
The friction and wear of lubricated Si3N4/SiC(w) composites
[DE90-015790] N90-29448

SILICONE RESINS
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511

SILOXANES
Effect of particulate fillers on the rheology of polymer melts
[AD-A223601] N90-29512

SILVER
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517

SIMULATION
Comparison of joint space versus task force load dictribution optimization for a multiarm manipulator system N90-29873
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
Temporal logics meet telerobotics N90-29905
Shuttle remote manipulator system mission preparation and operations N90-29909
Innovative uses of parallel computers
[AD-A223578] N90-29980

SIMULATORS
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed
[AD-A223448] N90-29549

SINGLE CRYSTALS
Studies on crack mechanics
[AD-A223634] N90-29670
Surface photovoltage spectroscopy of real n-type GaAs(110) surfaces
[DE90-627325] N90-30092

SINGLE EVENT UPSETS
An advanced single event upset tester
[AD-A223613] N90-30163

SINTERING
Powder processing of aluminides
[DE90-015314] N90-29447
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520

SITE SELECTION
The potential for an extra runway at Heathrow: A preliminary feasibility study
[TT-9007] N90-29403

SKIN TEMPERATURE (NON-BIOLOGICAL)
The skin temperature of mountain slopes and the determination of the sensible heat flux
[DLR-FB-90-07] N90-29754

SLEEP
Pharmacological resetting of the circadian sleep-wake cycle effects of triazolam on reentrainment of circadian rhythms in a diurnal primate
[AD-A224227] N90-29764
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770

SLEEP DEPRIVATION
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770
SLENDER BODIES
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
SLIDING FRICTION
Scale effects in steady-state friction
[DE90-012943] N90-29647
SNELLS LAW
Vehicle path-planning in three dimensions using optics analogs for optimizing visibility and energy cost N90-29853
SOFTWARE ENGINEERING
System software for Soviet computers N90-29921
AHTO project: Software technology for open distributed processing
[PB90-190943] N90-29923
Effects of parameter uncertainties on software development effort estimates
[AD-A223304] N90-29938
Software development: A product life-cycle perspective
[AD-A223783] N90-29952
SOFTWARE TOOLS
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
Programming your way out of the past: ISIS and the META Project
[NASA-CR-186275] N90-29922
MacRootLocus: A CAD design tool for feedback control systems
[AD-A223772] N90-29951
ESTEC software catalogue
[ESA-SP-1133] N90-29968
Supporting large scale applications on networks of workstations
[NASA-CR-186346] N90-29975
Assessment System for Aircraft Noise (ASAN): Development of alpha-test prototype system software
[AD-A223770] N90-30036
SOL-GEL PROCESSES
Kinetics and structure of silicate sol-gels
[DE90-015702] N90-29521
SOLAR CELLS
Basic studies of 3-V high efficiency cell components
[DE90-000360] N90-29696
SOLAR COLLECTORS
Some studies related to a new Hexagonal Compound Parabolic Concentrator (HCPC) as a secondary in tandem with a solar tower
[DLR-FB-90-12] N90-29700
SOLAR CYCLES
Trend analysis of total ozone data N90-29703
SOLAR FLARES
Search for neutrino events in the Kamiokande-2 detector in correlation with the solar-flare activity in March 1989
[DE90-508085] N90-30160
SOLAR GENERATORS
Some studies related to a new Hexagonal Compound Parabolic Concentrator (HCPC) as a secondary in tandem with a solar tower
[DLR-FB-90-12] N90-29700
SOLAR PHYSICS
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
The Ulysses data book: A summary of the technical elements of the Ulysses spacecraft and its scientific payload
[ESA-BR-65] N90-29427
Activities report of the Space Science Department
[ESA-SP-1126] N90-30142
SOLAR RADIATION
The Ulysses data book: A summary of the technical elements of the Ulysses spacecraft and its scientific payload
[ESA-BR-65] N90-29427
SOLAR SENSORS
High altitude balloon flight test of the GRAD experiment
[AD-A224398] N90-29388
SOLAR TERRESTRIAL INTERACTIONS
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
SOLAR WIND
Interplanetary medium data book, supplement 4, 1985-1988
[NASA-TM-101867] N90-30149
SOLDERED JOINTS
Proceedings of the 14th Annual Electronics Manufacturing Seminar
[AD-A224276] N90-29563
SOLID ELECTROLYTES
Electrochemical characteristics of acid electrolytes for fuel cells
[PB90-244385] N90-29693
Advanced materials and electrochemical processes in high-temperature solid electrolytes
[DE90-015552] N90-30104
SOLID LUBRICANTS
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
SOLID PROPELLANT COMBUSTION
Solid fuel combustion chamber
[LR-634] N90-29433
Spectroscopy of propellant-related flames
[AD-A224068] N90-29525
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526
SOLID ROCKET PROPELLANTS
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526
SOLID STATE DEVICES
Application of a rechargeable, small caliber railgun power supply
[AD-A224207] N90-29418
SOLIDIFICATION
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
A welding metallurgy study of Hastelloy Alloys B-2 and W
[DE90-011910] N90-29481
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
Single-phase solidification during rapid resolidification of stainless steel alloys
[DE90-015190] N90-29483
SOLIDIFIED GASES
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
SOLUTES
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
Single-phase solidification during rapid resolidification of stainless steel alloys
[DE90-015190] N90-29483
SOLUTIONS
Microscopic models for electromagnetic wave propagation in highly dispersive media
[AD-A224382] N90-29540
SOLVENTS
Processing of polymers using supercritical fluids
[AD-A223681] N90-29514
SONAR
Angle sample variance of azimuthally spread scattering processes, using a two-element array
[AD-A223572] N90-30034
SOS (SEMICONDUCTORS)
Parametric testing for the RSRE CMOS, silicon on sapphire process
[RSRE-MEMO-4369] N90-30115
SOUND GENERATORS
Investigation of a heat driven thermoacoustic prime mover
[AD-A223928] N90-29694
SOUND PRESSURE
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033
SOUND WAVES
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032
SOUTHEAST ASIA
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166
SOUTHERN HEMISPHERE
An observational study of the circulation in the Southern Hemisphere stratosphere N90-29715
SPACE ERECTABLE STRUCTURES
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
A lunar space station
[NASA-CR-186223] N90-30158
SPACE EXPLORATION
The flight telerobotic servicer: NASA's first operational space robot N90-29781
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
SPACE FLIGHT
The flight telerobotic servicer project: A technical overview N90-29821
SPACE HABITATS
A lunar space station
[NASA-CR-186223] N90-30158
SPACE MAINTENANCE
Telerobotic workstation design aid N90-29805
SPACE MISSIONS
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations
[NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations
[NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition
[NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume
[NASA-TM-101913] N90-29416
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations
[NASA-TM-101880] N90-30123
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations
[NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations
[NASA-TM-89695] N90-30148
A guide to the National Space Science Data Center
[NASA-TM-89637] N90-30167
SPACE NAVIGATION
Theoretical specifications of the trajectory estimation for a space navigation system with the function of guidance and control
[NAL-TR-1032] N90-29420
SPACE PLATFORMS
Guidance algorithms for a free-flying space robot N90-29798
SPACE PROCESSING
Influence of convection on microstructure
[NASA-CR-186506] N90-29470

A lunar space station
[NASA-CR-186223] N90-30158
SPACE SHUTTLE ORBITERS
Thermal analyses of power subsystem components
[NASA-CR-186314] N90-29637
SPACE SHUTTLE PAYLOADS
An advanced telerobotic system for shuttle payload changeout room processing applications N90-29795
SPACE SHUTTLES
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166
SPACE SIMULATORS
An introductory guide preparing to use the ESTEC environmental test facilities
[ESA-TM-05] N90-29419
SPACE STATION PAYLOADS
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
SPACE STATION POWER SUPPLIES
A lunar space station
[NASA-CR-186223] N90-30158
SPACE STATION STRUCTURES
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
A lunar space station
[NASA-CR-186223] N90-30158
SPACE STATIONS
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
A new momentum management controller for the space station
[NASA-CR-187265] N90-29425
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430
SPACE TRANSPORTATION
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE)
[NAL-TR-1028] N90-29330
SPACE TRANSPORTATION SYSTEM
Shuttle remote manipulator system mission preparation and operations N90-29909
SPACEBORNE EXPERIMENTS
Pointing control system for the Teal Ruby experiment N90-29370
The Ulysses data book: A summary of the technical elements of the Ulysses spacecraft and its scientific payload
[ESA-BR-65] N90-29427
Characteristics of pushbroom scanning type radiometer utilizing linear sensors
[NAL-TR-1024] N90-29625
SPACECRAFT COMPONENTS
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
SPACECRAFT CONTAMINATION
Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
SPACECRAFT CONTROL
The control of space manipulators subject to spacecraft attitude control saturation limits N90-29871
Performance constraints and compensation for teleoperation with delay N90-29881
SPACECRAFT DESIGN
A lunar space station
[NASA-CR-186223] N90-30158
SPACECRAFT POWER SUPPLIES
Thermal analyses of power subsystem components
[NASA-CR-186314] N90-29637
SPACECRAFT PROPULSION
AFOSR/ONR Contractors' Meeting on Combustion Rocket Propulsion Diagnostics of Reacting Flow
[AD-A224411] N90-29432
SPATIAL DISTRIBUTION
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
Special purpose spatial light modulators
[AD-A223794] N90-30052
SPATIAL RESOLUTION
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29628
SPECIFIC HEAT
Estimation of liquid heat capacities. 1: Review and evaluation of Missenard method
[AD-A224161] N90-29454
SPECIFICATIONS
Survey of formal specification techniques for reactive systems
[AD-A223741] N90-30005
SPECKLE INTERFEROMETRY
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
SPECTRA
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE90-015220] N90-29485
IUE-ULDA access guide no. 2. International Ultraviolet Explorer-Uniform Low Dispersion Archive: Comets
[ESA-SP-1134] N90-30157
SPECTRAL ENERGY DISTRIBUTION
The effects on antenna-filtered scintillation parameters of non-zero antenna pointing angles
[AD-A223840] N90-29554
SPECTRAL RESOLUTION
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
SPECTRAL SENSITIVITY
High power oblique incidence HF ionospheric modification
[AD-A224402] N90-29729
SPECTROMETERS
Planar waveguide spectrometer
[DE90-016308] N90-30057
SPECTROSCOPIC TELESCOPES
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
XMM space telescope: Development plan for the lightweight replicated x ray gratings
[DE90-015620] N90-30055
SPECTROSCOPY
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE90-015220] N90-29485
Kinetics and structure of silicate sol-gels
[DE90-015702] N90-29521
Planar waveguide spectrometer
[DE90-016308] N90-30057
Surface photovoltage spectroscopy of real n-type GaAs(110) surfaces
[DE90-627325] N90-30092
SPECTRUM ANALYSIS
Integrating rule-based and neural-net techniques for spectral analysis
[AD-A223517] N90-29462
Technique for the measurement of noise of the flow associated to the small wave numbers of the turbulence spectra
[ETN-90-97558] N90-29601
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
SPEECH RECOGNITION
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic
[AD-A223611] N90-29552
SPEED CONTROL
Optimal payload rate limit algorithm for zero-G manipulators N90-29858
SPEED INDICATORS
Detectors and signal processing for the speed measuring system 4-01
[FEL-1989-64] N90-29623
SPIN-LATTICE RELAXATION
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088
SPREAD SPECTRUM TRANSMISSION
PLRS: A new spread spectrum position location reporting system N90-29358
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic
[AD-A223611] N90-29552
SPUTTERING
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
STABILITY
An instability theorem for a certain sixth order differential equation
[DE90-627150] N90-29990
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
STABILITY AUGMENTATION
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399
STABILITY TESTS
Improved meteorological measurements from buoys and ships (IMET): Preliminary report on barometric pressure sensors
[PB90-242116] N90-29748
STABILIZATION
Chemical stabilization of laser dyes
[AD-A224219] N90-29627
STAINLESS STEELS
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
Single-phase solidification during rapid resolidification of stainless steel alloys
[DE90-015190] N90-29483
STANDARDS
Microscopic models for electromagnetic wave propagation in highly dispersive media
[AD-A224382] N90-29540
Radar receiver procedures
[AD-A224399] N90-29541
STAR FORMATION RATE
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152
STARK EFFECT
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interactions
[AD-A224282] N90-30065
Lectures in plasma diagnostics
[DE90-015825] N90-30086
STARS
Formation of hydrogen line and continuum emission in young stellar objects N90-30150
STARTERS
The dc arc weld starter
[DE90-014679] N90-29641
STATE ESTIMATION
State estimation for systems moving through random fields N90-29373
STATE VECTORS
Optimal control law phenomena in certain adaptive second-order observation systems
[AD-A224274] N90-29986
STATIC TESTS
Nonlinear modeling of joint dominated structures
[NASA-CR-4324] N90-29423
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
STATIONS
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722
STATISTICAL ANALYSIS
UK airmisses involving commercial air transport: May - August 1989
[ISSN-0951-6301] N90-29335
A single wafer bit-sliced convolver: An optimum statistical solution for the implementation of redundancy
[REPT-89-019] N90-29584
Counter-current flow limitation in thin rectangular channels
[DE90-015124] N90-29599
Time series, statistics, and information
[AD-A224317] N90-30018
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049
STATISTICAL DISTRIBUTIONS
Techniques for autonomous GPS integrity monitoring N90-29345
Barotropic mechanisms associated with tropical plume formation N90-29719
Effects of parameter uncertainties on software development effort estimates
[AD-A223304] N90-29938
Classical and Bayes-P subset selection procedures for double exponential populations
[AD-A223830] N90-30006
STATISTICAL TESTS
Unification of statistical methods for continuous and discrete data
[AD-A224307] N90-30017
STEADY STATE
Scale effects in steady-state friction
[DE90-012943] N90-29647
STEEL STRUCTURES
Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design
[DE90-016039] N90-29491
STEELS
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F
[PB90-207796] N90-29471

Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design
[DE90-016039] N90-29491

STEERABLE ANTENNAS
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372

STELLAR COLOR
An observational study of disk-population globular clusters N90-30145

STELLAR EVOLUTION
An observational study of disk-population globular clusters N90-30145
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152

STELLAR LUMINOSITY
Formation of hydrogen line and continuum emission in young stellar objects N90-30150
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152

STELLAR MAGNITUDE
An observational study of disk-population globular clusters N90-30145

STELLAR MODELS
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152

STELLAR ROTATION
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143

STELLAR SPECTRA
Monte Carlo simulation of complex spectra for opacity calculations
[DE90-015196] N90-30147

STELLAR TEMPERATURE
The Tempel 2 dust trail
[AD-A224595] N90-30153

STEREOSCOPIC VISION
Trinocular stereovision using figural continuity, dealing with curved objects N90-29802
Use of 3D vision for fine robot motion N90-29804

STERILIZATION
Factors affecting practical application of food irradiation
[DE90-631277] N90-29914

STOCHASTIC PROCESSES
Regional phase propagation in three dimensionally heterogeneous media
[AD-A223279] N90-29731
Geophysical turbulence research at NCAR
[AD-A223361] N90-29732
Optimal control law phenomena in certain adaptive second-order observation systems
[AD-A224274] N90-29986
Propagation of chaos and the McKean-Vlasov equation in duals of nuclear spaces
[AD-A224431] N90-30039
Stochastic properties of the plasma wave heating map
[DE90-508077] N90-30070

STOPPING
Laser beam stop
[AD-D014595] N90-29629

STRAIN DISTRIBUTION
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437

STRAIN HARDENING
Studies on crack mechanics
[AD-A223634] N90-29670
A method for modeling kinematic hardening and cyclic strain effects
[ONERA-RT-77/1765-RY-089-R] N90-29677

STRAIN RATE
Processability and high temperature behavior of emerging aerospace alloys
[AD-A224285] N90-29475
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663

STRANGENESS
Fast pulsars, strange stars: An opportunity in radio astronomy
[DE90-015630] N90-30155

STRAPDOWN INERTIAL GUIDANCE
Integration of GPS and strapdown inertial subsystems into a single unit N90-29340
Kalman filter formulations for transfer alignment of strapdown inertial units N90-29342
Integration of GPS/INS with partitioned filters N90-29347
Integrated strapdown avionics for precision guided vehicles N90-29361
Integrated navigation/flight control for future high performance aircraft N90-29362
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372

STRATEGY
Search strategies for computer-stored information: A microcomputer tutorial N90-30126

STRATOSPHERE
An observational study of the circulation in the Southern Hemisphere stratosphere N90-29715
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29726

STRATOSPHERIC WARMING
An observational study of the circulation in the Southern Hemisphere stratosphere N90-29715

STREAK CAMERAS
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system
[DE90-015203] N90-29620
Long-term flat-field behavior in LLNL streak cameras: Preliminary results
[DE90-015615] N90-29621

STRESS (PHYSIOLOGY)
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
Optimism and cardiovascular reactivity to psychological and cold pressor stress
[AD-A223818] N90-29771

STRESS (PSYCHOLOGY)
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects
[AD-A223635] N90-29769
Optimism and cardiovascular reactivity to psychological and cold pressor stress
[AD-A223818] N90-29771
Coping strategies and mood during cold weather training
[AD-A223915] N90-29773

STRESS ANALYSIS
Assessment and improvement of aeroengine disc structural integrity N90-29392
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming
[LR-621] N90-29451
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659

STRESS CORROSION
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507

STRESS CORROSION CRACKING
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507

STRESS CYCLES
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite
[AD-A223696] N90-29445

STRESS DISTRIBUTION
Studies on crack mechanics
[AD-A223634] N90-29670
An investigation of crack-tip stress field criteria for predicting cleavage-crack initiation
[DE90-015597] N90-29672

STRESS INTENSITY FACTORS
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683

STRESS MEASUREMENT
Evaluation of plane-of-light noninterference stress measurement systems for measuring bladed disk vibrations
[AD-A223487] N90-29667

STRESS RELAXATION
A viscoelastic material model for computing stresses in glass
[DE90-014851] N90-29673

STRESS-STRAIN RELATIONSHIPS
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663

STRESSES
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480
Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design
[DE90-016039] N90-29491
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663
A viscoelastic material model for computing stresses in glass
[DE90-014851] N90-29673

STRING THEORY
Effective actions for bosonic topological defects
[NASA-CR-187271] N90-30041
Introductory lectures on conformal field theory and strings
[DE90-627219] N90-30120

STRUCTURAL ANALYSIS
Generalized Advanced Propeller Analysis System (GAPAS). Volume 2: Computer program user manual
[NASA-CR-185277] N90-29394
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
Spatial structure of particle-orbit loss regions in l=2 helical systems
[DE90-508080] N90-30073

STRUCTURAL DESIGN
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
WingDesign: Program for the structural design of a wing cross-section
[LR-627] N90-29390
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design
[DE90-016039] N90-29491

STRUCTURAL ENGINEERING
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934

STRUCTURAL FAILURE
Assessment and improvement of aeroengine disc structural integrity N90-29392

STRUCTURAL RELIABILITY
Reliability study of TWT output RF window
[AD-A223688] N90-29574

STRUCTURAL STABILITY
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507

STRUCTURAL VIBRATION
A vector diagram approach to shaping inputs for vibration reduction
[AD-A223724] N90-29671
Preshaping command inputs to reduce telerobotic system oscillations N90-29880

STRUTS
Nonlinear modeling of joint dominated structures
[NASA-CR-4324] N90-29423

STYRENES
Toughening of SAN copolymers by an SAN emulsion grafted rubber
[AD-A224213] N90-29502

SUBSONIC SPEED
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596

SUBSTRATES
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518

SULFONIC ACID
Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes
[DE90-016626] N90-29699

SULFUR
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488

Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747

SUPERCONDUCTIVITY
Performance test plan for variable-speed ac superconducting motor
[DE90-016206] N90-29579
Practical superconductor development for electrical power applications
[DE90-014836] N90-30109
Superconductivity and information exchange
[DE90-015767] N90-30110

SUPERCONDUCTORS
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098

SUPERCRITICAL FLUIDS
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE90-015220] N90-29485
Processing of polymers using supercritical fluids
[AD-A223681] N90-29514

SUPERLATTICES
New real space correlated-basis-functions approach for the electron correlations of the semiconductor inversion layer
[DE90-627315] N90-30090
Effect of retardation on the reflectance properties of the metallic Fibonacci quasi-superlattice
[DE90-627316] N90-30091
The II-VI semiconductor superlattices
[AD-A223748] N90-30101

SUPERNOVAE
Prospects for nuclear astrophysics with intense radioactive ion beams
[DE90-015616] N90-30044

SUPERPLASTICITY
Processability and high temperature behavior of emerging aerospace alloys
[AD-A224285] N90-29475
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479

SUPERSATURATION
Mechanism of habit change for atmospheric ice crystal growth N90-29717
Rates of vertical mixing, gas exchange, and new production: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758

SUPERSONIC COMBUSTION RAMJET ENGINES
Numerical simulation supersonic free shear layers
[AD-A223771] N90-29306
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397
Analysis of scramjet engine characteristics
[NAL-TR-1041] N90-29398
AFOSR/ONR Contractors' Meeting on Combustion Rocket Propulsion Diagnostics of Reacting Flow
[AD-A224411] N90-29432

SUPERSONIC FLOW
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
Numerical simulation supersonic free shear layers
[AD-A223771] N90-29306
Thermal transfers in unsteady compressible inviscid flow
[ETN-90-97557] N90-29311
Theoretical study of the interaction between an oblique shock wave and a turbulent boundary layer from a heated wall
[ONERA-RSF-87/7078/AY-100-A] N90-29313

SUPERSONIC INLETS
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587

SUPERSONIC TEST APPARATUS
Laser induced fluorescence: Practical applications N90-29323

SUPERSYMMETRY
Higher order equations of motion
[DE90-627522] N90-30038

SURFACE CRACKS
The ACR-program for automatic finite element model generation for part through cracks
[DE90-631545] N90-29662

SURFACE DEFECTS
Light scattering from surface and sub-surface defects
[DE90-016311] N90-30058

SURFACE ENERGY
Mechanism of habit change for atmospheric ice crystal growth N90-29717

SURFACE NAVIGATION
Combining LORAN and GPS: The best of both worlds N90-29343
An Ada-based marine radar simulator for collision avoidance training
[ETN-90-97611] N90-29970

SURFACE PROPERTIES
Surface effect for test piece on flexural test of carbon fiber reinforced plastic laminates
[NAL-TM-601] N90-29436
On hydrogen chemisorption on metals: The electron correlation effects
[DE90-627318] N90-29473
Thermal imaging assessment
[AD-A224400] N90-29542
Theoretical and experimental comparison of infrared and visible laser scattering from a variety of surface types
[RSRE-MEMO-4348] N90-29636
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095

SURFACE REACTIONS
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507

SURFACE ROUGHNESS
Estimation of power spectral density of runway roughness
[NAL-TR-1037] N90-29411
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions
[BR114894] N90-29646

SURFACE TEMPERATURE
Thermographic phosphor technique N90-29324

SURFACE VEHICLES
The flight telerobotic servicer: NASA's first operational space robot N90-29781

SURFACE WAVES
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571
Research in nonlinear water waves
[AD-A224065] N90-29759
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032

SURVEILLANCE
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730

SURVEYS
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis
[DE90-008944] N90-29778

SUSPENDING (HANGING)
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424

SWELLING
Swelling of neutron irradiated vanadium alloys
[DE90-015294] N90-29472
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485

SWITZERLAND
Trend analysis of total ozone data N90-29703

SYMBOLIC PROGRAMMING
Optical symbolic processor for expert system execution
[AD-A224284] N90-29931
Optical signal computing
[AD-A223624] N90-30051

SYMMETRY
Symmetrical layered thin film edge field-emitter-array and method for its production
[AD-D014594] N90-29569
Symmetry and island structure of the standard map
[DE90-506076] N90-30069

SYNCHRONISM
Fact system: A standardizing modelization processing for concurrent systems
[ETN-90-97286] N90-29982

SYNCHRONOUS SATELLITES
A three axis attitude control of a satellite
[NASDA-TR-22] N90-29421
Satellite motion in an axi-symmetric gravitational field. Part 1: Perturbations due to J2 (second order) and J3
[RAE-TR-88068] N90-29429

SYNCHROTRON RADIATION
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049

SYNTAX
Formal semantics of SQL queries
[REPT-89-089] N90-29973

SYNTHESIS (CHEMISTRY)
Novel macrocyclic carriers for proton-coupled liquid membrane transport
[DE90-015529] N90-29453
Pyrromethene-BF2 complexes as laser dyes
[AD-A223562] N90-29631
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098

SYNTHETIC APERTURE RADAR
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372
Detection and analysis of wind fronts and current shear in digital SAR images
[FFI-89/7016] N90-29755

SYNTHETIC FUELS
Production of jet fuels from coal-derived liquids. Volume 13: Evaluation of storage and thermal stability of jet fuels derived from coal liquids
[AD-A224576] N90-29527

SYSTEM FAILURES
Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977

SYSTEMS ANALYSIS
A vector diagram approach to shaping inputs for vibration reduction
[AD-A223724] N90-29671
RCTS: A flexible environment for sensor integration and control of robot systems; the distributed processing approach N90-29852
Survey of formal specification techniques for reactive systems
[AD-A223741] N90-30005

SYSTEMS ENGINEERING
Electro-optics engineering support for the integrated launch and recovery television surveillance system
[AD-A223450] N90-29406
Techniques for developing a system safety risk assessment model
[AD-A223477] N90-29654
Telerobotic workstation design aid N90-29805
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942
Working implementation agreements for open systems interconnection protocols
[PB90-197948] N90-30127

SYSTEMS INTEGRATION
Integration of GPS and strapdown inertial subsystems into a single unit N90-29340
The integration of multiple avionic sensors and technologies for future military helicopters N90-29344
Integration of GPS/INS with partitioned filters N90-29347
Integrated strapdown avionics for precision guided vehicles N90-29361
Integrated navigation/flight control for future high performance aircraft N90-29362
A low cost inertial/GPS integrated approach to land navigation N90-29374
An integrated system for land navigation N90-29377

SYSTEMS SIMULATION
Workshop on Low Level Flight Training
[AGARD-AR-288] N90-29404

SYSTOLIC ARRAYS
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953

T

TABLES (DATA)
Brorfelde Geomagnetic Observatory: Magnetic results, 1987
[ISBN-87-7478-297-5] N90-29756

TACTILE DISCRIMINATION
Force/torque and tactile sensors for sensor-based manipulator control N90-29791

TANTALUM
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions
[BR114894] N90-29646

TARGET ACQUISITION
Investigation method for AA-proximity fuses
[FEL-89-A194] N90-29535
Airborne target detection, acquisition, and tracking devices
[AD-A223852] N90-29555

TARGET RECOGNITION
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies [AD-A224358] N90-29539
Airborne target detection, acquisition, and tracking devices [AD-A223852] N90-29555
Evaluation of a potential Wave Division Multiplexer (WDM) for use in the IRSTD [AD-A223945] N90-29560
TARGETS
Airborne target detection, acquisition, and tracking devices [AD-A223852] N90-29555
A 94 GHz transmissometer [AD-A223309] N90-29618
TASK COMPLEXITY
Uniform task level definitions for robotic system performance comparisons N90-29855
TASKS
Ability and metacognitive determinants of skill acquisition and transfer [AD-A224589] N90-29776
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis [DE90-008944] N90-29778
Uniform task level definitions for robotic system performance comparisons N90-29855
Assembly of objects with not fully predefined shapes N90-29859
Precedence relationship representations of mechanical assembly sequences N90-29866
Determining robot actions for tasks requiring sensor interaction N90-29868
Visual processing: Implications for helmet mounted displays [AD-A223488] N90-29916
TECHNOLOGICAL FORECASTING
The integration of multiple avionic sensors and technologies for future military helicopters N90-29344
TECHNOLOGY ASSESSMENT
Measurement Techniques for Hypersonic Flows [VKI-LS-1990-05] N90-29314
The 2-D and 3-D characterizations of GPS navigation service N90-29348
ECS: Sixth year in orbit [ESA-BR-70] N90-29428
System software for Soviet computers N90-29921
TECHNOLOGY TRANSFER
Diagnostic development and support of MHD test facilities [DE90-015403] N90-30083
Superconductivity and information exchange [DE90-015767] N90-30110
The technology transfer process: Background for the national energy strategy [DE90-015301] N90-30139
TECHNOLOGY UTILIZATION
An introductory guide preparing to use the ESTEC environmental test facilities [ESA-TM-05] N90-29419
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests [NAL-TR-1040] N90-29657
Integration of a sensor based multiple robot environment for space applications: The Johnson Space Center Teleoperator Branch Robotics Laboratory N90-29890
TECTONICS
Some aspects of the structure and evolution of oceanic spreading centers N90-29757
TELECOMMUNICATION
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29891
TELEMETRY
Database development for the DMSP experiments [AD-A224346] N90-30129
TELEOPERATORS
Proceedings of the NASA Conference on Space Telerobotics, volume 3 [NASA-CR-186858] N90-29780
The flight telerobotic servicer: NASA's first operational space robot N90-29781
Traction-drive force transmission for telerobotic joints N90-29790
Redundant sensorized arm+hand system for space telerobotized manipulation N90-29792
Impedance hand controllers for increasing efficiency in teleoperations N90-29793
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794
An advanced telerobotic system for shuttle payload changeout room processing applications N90-29795
Robotic tele-existence N90-29796
Telepresence system development for application to the control of remote robotic systems N90-29799
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
A fast 3-D object recognition algorithm for the vision system of a special-purpose dexterous manipulator N90-29803
Telerobotic workstation design aid N90-29805
Space robotic system for proximity operations N90-29806
Control strategies for a telerobot N90-29808
Learning in tele-autonomous systems using Soar N90-29819
Design of a structural and functional hierarchy for planning and control of telerobotic systems N90-29820
The flight telerobotic servicer project: A technical overview N90-29821
The flight telerobotic servicer Tinman concept: System design drivers and task analysis N90-29822
The flight telerobotic servicer: From functional architecture to computer architecture N90-29823
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
The Goddard Space Flight Center (GSFC) robotics technology testbed N90-29825
Test and validation for robot arm control dynamics simulation N90-29826
Graphic overlays in high-precision teleoperation: Current and future work at JPL N90-29827
Use of graphics in decision aids for telerobotic control: (Parts 5-8 of an 8-part MIT progress report) N90-29829
Proceedings of the NASA Conference on Space Telerobotics, volume 4 [NASA-CR-186859] N90-29830
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
Response to reflected-force feedback to fingers in teleoperations N90-29837
The JAU-JPL anthropomorphic telerobot N90-29838
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
Sensor-based fine telemanipulation for space robotics N90-29841
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Information management in an integrated space telerobot N90-29846
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
Linear analysis of a force reflective teleoperator N90-29856
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Optimal payload rate limit algorithm for zero-G manipulators N90-29858
The laboratory telerobotic manipulator program N90-29869
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870
System architectures for telerobotic research N90-29872
Proceedings of the NASA Conference on Space Telerobotics, volume 5 [NASA-CR-186860] N90-29874
Telerobotic activities at Johnson Space Center N90-29875
A control approach for robots with flexible links and rigid end-effectors N90-29879
Preshaping command inputs to reduce telerobotic system oscillations N90-29880
Performance constraints and compensation for teleoperation with delay N90-29881
Flight telerobotic servicer control from the Orbiter N90-29882
Teleoperation experiments with a Utah/MIT hand and a VPL DataGlove N90-29883
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
Establishing viable task domains for telerobot demonstrations N90-29886
The telerobot workstation testbed for the shuttle aft flight deck: A project plan for integrating human factors into system design N90-29887
An alternative control structure for telerobotics N90-29889
Integration of a sensor based multiple robot environment for space applications: The Johnson Space Center Teleoperator Branch Robotics Laboratory N90-29890
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
Flight experiments in telerobotics-Orbiter middeck concept N90-29895
The astronaut and the banana peel: An EVA retriever scenario N90-29897
Next generation space robot N90-29899
Distributed communications and control network for robotic mining N90-29901
Temporal logics meet telerobotics N90-29905
An intelligent, free-flying robot N90-29912
Approach to telerobot computing architecture [NASA-CR-186993] N90-29984
TEMPERATE REGIONS
Barotropic mechanisms associated with tropical plume formation N90-29719
TEMPERATURE CONTROL
A cost-effective realization of environmental temperature control [DE90-011651] N90-29532
Thermal analyses of power subsystem components [NASA-CR-186314] N90-29637
TEMPERATURE DEPENDENCE
Proceedings of a discussion meeting on Thermodynamics of Alloys [AD-A224396] N90-29476
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy [AD-A223676] N90-29480
TEMPERATURE DISTRIBUTION
Calculation of turbulent air streams in driver cabs [ETN-90-97320] N90-29310
TEMPERATURE EFFECTS
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite [AD-A223696] N90-29445
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C [NASA-TM-102699] N90-29450
Isotopic tailoring and other techniques used to study helium effects in austenitic alloys [DE90-016344] N90-29495
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions [BR114894] N90-29646
A viscoelastic material model for computing stresses in glass [DE90-014851] N90-29673
Mechanism of habit change for atmospheric ice crystal growth N90-29717
TEMPERATURE GRADIENTS
Investigation of a heat driven thermoacoustic prime mover [AD-A223928] N90-29694
TEMPERATURE MEASUREMENT
Feasibility of the temperature measurements in hypersonic flow by multibeam coherent Raman anti-Stokes scattering [ONERA-RF-56/7131-PY] N90-29312
Measurement Techniques for Hypersonic Flows [VKI-LS-1990-05] N90-29314
CARS spectroscopy and applications N90-29321
Thermographic phosphor technique N90-29324
Infrared thermography N90-29325
Recommended practices for measurement of gas path pressures and temperatures for performance assessment of aircraft turbine engines and components [AGARD-AR-245] N90-29393
TEMPERATURE PROFILES
An investigation of the inviscid spatial instability of compressible mixing layers [AD-A223776] N90-29596
TEMPERATURE RATIO
An investigation of the inviscid spatial instability of compressible mixing layers [AD-A223776] N90-29596
TENSILE PROPERTIES
Evaluation of ARALL-4: An aramid fiber reinforced aluminum [AD-A223502] N90-29443
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F [PB90-207796] N90-29471
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra [DE90-015295] N90-29485
Alloy design of ordered intermetallics [DE90-016031] N90-29490

The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496

TENSILE STRENGTH
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446
Effects of low Chromium(3) concentration in electrodeposition of low contraction chromium
[AD-A223338] N90-29477
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683

TENSILE STRESS
Processability and high temperature behavior of emerging aerospace alloys
[AD-A224285] N90-29475

TENSORS
The f2 dominance of the energy-momentum tensor
[DE90-508027] N90-29544
A new vector-tensor theory and higher-dimensional cosmology
[DE90-507990] N90-30117

TERNARY ALLOYS
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485

TERRAIN ANALYSIS
Survivable penetration N90-29363
A land navigation demonstration vehicle with a color map display for tactical use N90-29375
Terrain visual cue analysis for simulating low-level flight: A multidimensional scaling approach
[AD-A223564] N90-29407

TEST CHAMBERS
Analysis and design of modifications for improved performance of the AFIT radar cross section measurement chamber
[AD-A223352] N90-29545

TEST EQUIPMENT
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
The laboratory telerobotic manipulator program N90-29869
The telerobot workstation testbed for the shuttle aft flight deck: A project plan for integrating human factors into system design N90-29887
Next generation space robot N90-29899

TEST FACILITIES
An introductory guide preparing to use the ESTEC environmental test facilities
[ESA-TM-05] N90-29419
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
Diagnostic development and support of MHD test facilities
[DE90-015403] N90-30083

TEST STANDS
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed
[AD-A223446] N90-29549

TEXTS
Textual regularities applicable to full text searching: The case of family history literature N90-30125

TEXTURES
A global approach to image texture analysis
[AD-A223532] N90-29941

THEOREM PROVING
Oscillatory and nonoscillatory behaviour of solutions of an equation alternately of retarded and advanced type
[DE90-627159] N90-29993
Tail and quantile estimation for strongly mixing stationary sequences
[AD-A223472] N90-30019

THEOREMS
An instability theorem for a certain sixth order differential equation
[DE90-627150] N90-29990

THEORETICAL PHYSICS
An instability theorem for a certain sixth order differential equation
[DE90-627150] N90-29990
Periodic solutions of certain fifth order differential equations
[DE90-627160] N90-29994

THERMAL ANALYSIS
A welding metallurgy study of Hastelloy Alloys B-2 and W
[DE90-011910] N90-29481
Thermal analysis of bismaleimide matrix resins
[DE90-016283] N90-29523
Thermal analyses of power subsystem components
[NASA-CR-186314] N90-29637
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105

THERMAL BOUNDARY LAYER
Spectral measurements of the wall shear stress and wall pressure in a turbulent boundary layer: Theory
[AD-A224070] N90-29586

THERMAL CYCLING TESTS
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480

THERMAL EXPANSION
A cost-effective realization of environmental temperature control
[DE90-011651] N90-29532

THERMAL FATIGUE
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C
[NASA-TM-102699] N90-29450
A viscoelastic material model for computing stresses in glass
[DE90-014851] N90-29673

THERMAL MAPPING
Thermal imaging assessment
[AD-A224400] N90-29542

THERMAL PROTECTION
Design and evaluation of candidate pressure distribution and air data system tile penetration for the aeroassist flight experiment
[NASA-CR-4312] N90-29615

THERMAL STABILITY
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers
[AD-A223409] N90-29509

THERMAL STRESSES
Reliability study of TWT output RF window
[AD-A223686] N90-29574

THERMISTORS
Evaluation of a thermistor power measurement system for use on the NPL antenna extrapolation range
[NPL-DES-89] N90-29583

THERMITES
An effective low-profile thermite torch
[DE90-015746] N90-29534

THERMOCHEMISTRY
Thermochemical data for silicon-containing species from ab initio electronic structure calculations
[DE90-011024] N90-29463

THERMOCLINES
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758

THERMODYNAMIC CYCLES
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397

THERMODYNAMIC EFFICIENCY
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064

THERMODYNAMIC PROPERTIES
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Statistically designed study of the variables and parameters of carbon dioxide equations of state
[DE90-016196] N90-29467
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480
Piezoelectric and electrostrictive materials for transducer applications, volume 2
[AD-A223561] N90-29669

THERMODYNAMICS
Estimation of liquid heat capacities. 1: Review and evaluation of Missenard method
[AD-A224161] N90-29454
Proceedings of a discussion meeting on Thermodynamics of Alloys
[AD-A224336] N90-29476
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
The worldwide ionospheric data base
[NASA-TM-101823] N90-29714
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746

THERMOELASTICITY
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658

THERMOGRAPHY
Thermographic phosphor technique N90-29324
Infrared thermography N90-29325
Studies of surface heat transfer in an arc-heated wind tunnel
[NAL-TR-1048] N90-29410

THERMOMECHANICAL TREATMENT
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479

THERMOPLASTIC RESINS
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite
[AD-A223696] N90-29445
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming
[LR-621] N90-29451
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459

THERMOSPHERE
Atmospheric structure and variability
[AD-A223439] N90-29734

THICKNESS
Nondestructive material characterization
[DE90-015176] N90-29652

THIN FILMS
Symmetrical layered thin film edge field-emitter-array and method for its production
[AD-D014594] N90-29569
Piezoelectric and electrostrictive materials for transducer applications, volume 1
[AD-A223560] N90-29668
Transmission electron microscopy study of ICB Al on Ge and Si(001) substrates
[DE90-015299] N90-30103

THREE AXIS STABILIZATION
A three axis attitude control of a satellite
[NASDA-TR-22] N90-29421

THREE DIMENSIONAL BOUNDARY LAYER
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302

THREE DIMENSIONAL FLOW
Numerical simulation supersonic free shear layers
[AD-A223771] N90-29306
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
Three dimensional studies of helical equilibria and magnetic surface breaking due to the finite beta effect
[DE90-508078] N90-30071

THREE DIMENSIONAL MODELS
A package for 3-D unstructured grid generation, finite-element flow solution and flow field visualization
[NASA-CR-182090] N90-29309
Comparison of crack closure result obtained by 3D elastic-plastic FEM and modified Dugdale model
[FFA-TN-1990-18] N90-29675
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746
The 3D model control of image processing N90-29800

THRUST LOADS
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651

THUNDERSTORMS
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744

Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries
N90-29746

TILES
Design and evaluation of candidate pressure distribution and air data system tile penetration for the aeroassist flight experiment
[NASA-CR-4312] N90-29615

TILT ROTOR AIRCRAFT
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989
[AD-A224256] N90-29299

TIME DIVISION MULTIPLE ACCESS
PLRS: A new spread spectrum position location reporting system N90-29358

TIME LAG
Control and estimation for aerospace applications with system time delays N90-29367
Graphic overlays in high-precision teleoperation: Current and future work at JPL N90-29827
Performance constraints and compensation for teleoperation with delay N90-29881

TIME SERIES ANALYSIS
Time series, statistics, and information
[AD-A224317] N90-30018

TITANIUM
On hydrogen chemisorption on metals: The electron correlation effects
[DE90-627318] N90-29473
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494
Fundamental studies on intermetallic compounds
[ONERA-RT-4/1855-M] N90-29497
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions
[BR114894] N90-29646

TITANIUM ALLOYS
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
Realization of equipment for manufacturing titanium alloy electrodes for first step melting
[ONERA-RT-15/3578-M] N90-29498

TITANIUM OXIDES
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520

TOKAMAK DEVICES
Tokamak plasma shape identification with a Legendre-Fourier expansion of the vacuum poloidal flux function in the toroidal coordinates
[DE90-508031] N90-30068
A model of peaked density profile and inward pinch in tokamaks
[DE90-508079] N90-30072
Structure of magnetic field in tokamaks
[DE90-628904] N90-30075
Magnetic surfaces in tokamaks
[DE90-628905] N90-30076
Fundamental studies of fusion plasmas
[DE90-015732] N90-30080

TOLERANCES (PHYSIOLOGY)
A human factors engineering approach to the development and dynamic evaluation of a prototype aircrew seat for military aircraft
[AD-A218283] N90-29779

TOPOGRAPHY
Asymptotic code vector density in topographic vector quantisers
[RSRE-MEMO-4392] N90-30012

TOPOLOGY
Effective actions for bosonic topological defects
[NASA-CR-187271] N90-30041

TORCHES
An effective low-profile thermite torch
[DE90-015746] N90-29534

TORNADOES
Observations of tornadoes and wall clouds with a portable FM-CW Doppler radar: 1989--1990 results
[DE90-013152] N90-29752

TOROIDS
Compact toroid research
[DE90-016123] N90-30087

TORQUE
Force/torque and tactile sensors for sensor-based manipulator control N90-29791
Stability analysis of multiple-robot control systems N90-29811
Time optimal movement of cooperating robots N90-29815

TORSION
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663

TOUGHNESS
High performance brittle matrices and brittle matrix composites, book 2
[AD-A223274] N90-29441
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F
[PB90-207796] N90-29471
Toughening of SAN copolymers by an SAN emulsion grafted rubber
[AD-A224213] N90-29502

TOWED BODIES
Modeling towed cable system dynamics
[AD-A223610] N90-29644

TOWING
Modeling towed cable system dynamics
[AD-A223610] N90-29644

TRACKING (POSITION)
Control and estimation for aerospace applications with system time delays N90-29367
Airborne target detection, acquisition, and tracking devices
[AD-A223852] N90-29555
Autonomous sensor-based dual-arm satellite grappling N90-29809
IUE-ULDA access guide no. 2. International Ultraviolet Explorer-Uniform Low Dispersion Archive: Comets
[ESA-SP-1134] N90-30157

TRACTION
Traction-drive force transmission for telerobotic joints N90-29790

TRAFFIC
Satellite navigation systems for land vehicles N90-29376

TRAINING ANALYSIS
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis
[DE90-008944] N90-29778

TRAINING SIMULATORS
Study improvement training facilities ground control air traffic controllers. Part 1: Alternative solutions and their consequences
[FEL-89-A257-PT-1] N90-29380
Study improvement training facilities ground control air traffic controllers. Part 2: Functional analysis approach control trainer
[FEL-89-A280-PT-2] N90-29409
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
An Ada-based marine radar simulator for collision avoidance training
[ETN-90-97611] N90-29970

TRAJECTORIES
User's manual for the Trajectory Simulation and Analysis Program (TSAP)
[DE90-014850] N90-29426
Long pulse diode experiments
[DE90-016218] N90-29578
Windshear estimation along the trajectory of an aircraft N90-29745
Database development for the DMSP experiments
[AD-A224346] N90-30129

TRAJECTORY ANALYSIS
Theoretical specifications of the trajectory estimation for a space navigation system with the function of guidance and control
[NAL-TR-1032] N90-29420
User's manual for the Trajectory Simulation and Analysis Program (TSAP)
[DE90-014850] N90-29426

TRAJECTORY CONTROL
Redundancy of space manipulator on free-flying vehicle and its nonholonomic path planning N90-29797
Telepresence system development for application to the control of remote robotic systems N90-29799
Test and validation for robot arm control dynamics simulation N90-29826
An improved adaptive control for repetitive motion of robots N90-29831
Vehicle path-planning in three dimensions using optics analogs for optimizing visibility and energy cost N90-29853

TRAJECTORY OPTIMIZATION
Optimal trajectories for hypervelocity flight N90-29378
Theoretical specifications of the trajectory estimation for a space navigation system with the function of guidance and control
[NAL-TR-1032] N90-29420
Guidance algorithms for a free-flying space robot N90-29798
Space robotic system for proximity operations N90-29806
Vehicle path-planning in three dimensions using optics analogs for optimizing visibility and energy cost N90-29853
Optimal payload rate limit algorithm for zero-G manipulators N90-29858

TRANSDUCERS
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571

TRANSFER FUNCTIONS
Infrared thermography N90-29325
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402

TRANSFORMATIONS (MATHEMATICS)
Recognition by linear combination of models
[AD-A224268] N90-29029
New approaches to linear and nonlinear programming
[AD-A224328] N90-29932
Short encodings of evolving structures
[AD-A223641] N90-29944
A comparison of alternative families of transformations for variables constrained to lie on the interval (0,1)
[MATHS-REPT-A-126] N90-30011
Transformation group methods in plasma physics
[DE90-628755] N90-30074
On Dirac's conjecture for Hamiltonian systems with first and second class constraints
[DE90-627206] N90-30116

TRANSIENT RESPONSE
Analysis of dynamic transient response and postflutter behavior of super-maneuvering airplane
[AD-A224126] N90-29386

TRANSITION METALS
Transition metal activation and functionalization of carbon-hydrogen bonds
[DE90-015826] N90-29489

TRANSITION PROBABILITIES
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040

TRANSMISSION EFFICIENCY
Evaluation of a potential Wave Division Multiplexer (WDM) for use in the IRSTD
[AD-A223945] N90-29580

TRANSMISSOMETERS
A 94 GHz transmissometer
[AD-A223309] N90-29618

TRANSMITTANCE
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing
[AD-A224510] N90-29543

TRANSMITTERS
Radar clutter via ray methods
[AD-A223796] N90-29553

TRANSONIC FLOW
Some topics in computational transonic aerodynamics: Revision
[NAL-TR-1018T] N90-29332
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031

TRANSONIC WIND TUNNELS
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327

TRANSPORT PROPERTIES
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727

TRANSPORT THEORY
Fundamental studies of fusion plasmas
[DE90-015732] N90-30080

TRAPPED PARTICLES
NASA radiation belt models AP-8 and AE-8
[AD-A223660] N90-29737

TRAPPING
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166

TRAVELING WAVE TUBES
Reliability study of TWT output RF window
[AD-A223688] N90-29574

TRAVELING WAVES
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29568

Research into traveling wave control in flexible structures
[AD-A224504] N90-29661

TREES (MATHEMATICS)
Trees, bialgebras and intrinsic numerical algorithms
[NASA-CR-187031] N90-29925
Unique binary search tree representations and equality-testing of sets and sequences
[AD-A223643] N90-30002

TREND ANALYSIS
Trend analysis of total ozone data N90-29703

TRENDS
Trend analysis of total ozone data N90-29703

TRIBOLOGY
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
Wear of advanced ceramics: An overview
[DE90-012166] N90-29519
Scale effects in steady-state friction
[DE90-012943] N90-29647
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651

TROPICAL REGIONS
Barotropic mechanisms associated with tropical plume formation N90-29719

TROPOSPHERE
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
The Surface Air Sampling Program
[DE90-014873] N90-29711

TRUSSES
Nonlinear modeling of joint dominated structures
[NASA-CR-4324] N90-29423

TURBINE BLADES
Comparison of wind tunnel airfoil performance data with wind turbine blade data
[DE90-000343] N90-29308
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593

TURBINES
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327

TURBOCOMPRESSORS
Development of a software package for automatic data acquisition, analysis, and controls in an axial flow compressor test rig
[PD-PR-8910] N90-29926

TURBULENCE
An additive turbulent decomposition of the Navier-Stokes equations implemented on highly parallel computer systems
[AD-A223678] N90-29595
Unstable phenomena in mechanical systems
[AD-A223640] N90-30001

TURBULENCE MODELS
A boundary-layer transition model for the Navier-Stokes computation for a natural-laminar-flow airfoil
[NAL-TR-1038T] N90-29328
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Technique for the measurement of noise of the flow associated to the small wave numbers of the turbulence spectra
[ETN-90-97558] N90-29601

TURBULENT BOUNDARY LAYER
Theoretical study of the interaction between an oblique shock wave and a turbulent boundary layer from a heated wall
[ONERA-RSF-87/7078/AY-100-A] N90-29313
Spectral measurements of the wall shear stress and wall pressure in a turbulent boundary layer: Theory
[AD-A224070] N90-29586
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
Transition of the boundary layer
[DERAT-RSF-50/5018-37] N90-29600
Technique for the measurement of noise of the flow associated to the small wave numbers of the turbulence spectra
[ETN-90-97558] N90-29601

TURBULENT FLOW
Calculation of turbulent air streams in driver cabs
[ETN-90-97320] N90-29310
AFOSR/ONR Contractors' Meeting on Combustion Rocket Propulsion Diagnostics of Reacting Flow
[AD-A224411] N90-29432
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Direct numerical simulation of turbulent couette flow
[AD-A224287] N90-29589
Particle dispersion in a turbulent shear flow
[AD-A224327] N90-29590
Effects of 1 Hz imposed bulk flow unsteadiness on laminar/turbulent transition in a straight channel
[AD-A223396] N90-29594
Solid particle erosion in turbulent flows past tube banks
[DE90-015711] N90-29598

TURBULENT HEAT TRANSFER
Direct numerical simulation of turbulent couette flow
[AD-A224287] N90-29589
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593

TURBULENT JETS
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593

TWO DIMENSIONAL BODIES
A numerical calculation of hypersonic flow around blunt bodies using upwind difference scheme
[NAL-TR-1025] N90-29331

TWO DIMENSIONAL FLOW
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1046] N90-29326
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596

TWO DIMENSIONAL MODELS
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658
Trend analysis of total ozone data N90-29703
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
Experimental study on two-dimensional free-flying robot satellite model N90-29896
Computed torque control of a free-flying cooperating-arm robot N90-29898
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146

TWO PHASE FLOW
Velocity interferometry N90-29316

U

U.S.S.R.
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-004] N90-29688
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-003] N90-29689
JPRS Report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-007] N90-29762
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-004] N90-29763
System software for Soviet computers N90-29921

ULTRAHIGH VACUUM
An electron spin resonance study of adsorbed gases in ultrahigh vacuum
[ETN-90-97323] N90-29469

ULTRASONIC SOLDERING
Proceedings of the 14th Annual Electronics Manufacturing Seminar
[AD-A224276] N90-29563

ULTRASONICS
Robots, systems, and flexible automation
[DE90-015802] N90-29649

ULTRAVIOLET LASERS
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064

ULTRAVIOLET SPECTRA
The impact of IUE on studies of the nova outburst: 1986-1990
[DE90-014915] N90-30156

ULYSSES MISSION
The Ulysses data book: A summary of the technical elements of the Ulysses spacecraft and its scientific payload
[ESA-BR-65] N90-29427

UNIVERSE
Relic gravitational waves and extended inflation
[NASA-CR-186469] N90-29740

UNIVERSITIES
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137

UNSTEADY FLOW
Thermal transfers in unsteady compressible inviscid flow
[ETN-90-97557] N90-29311

UPPER ATMOSPHERE
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724

USER MANUALS (COMPUTER PROGRAMS)
Generalized Advanced Propeller Analysis System (GAPAS). Volume 2: Computer program user manual
[NASA-CR-185277] N90-29394
User's manual for the Trajectory Simulation and Analysis Program (TSAP)
[DE90-014850] N90-29426
Durra: A task-level description language user's manual
[AD-A223761] N90-29950
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954
Automated CADAM data transfer: User's manual
[DE90-014871] N90-29963

USER REQUIREMENTS
GPS integrity requirements for use by civil aviation N90-29339
Radar receiver procedures
[AD-A224399] N90-29541
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
Accessing network databases via SQL transactions in a multi-model database system
[AD-A223946] N90-30128

UTILIZATION
Establishing viable task domains for telerobot demonstrations N90-29886

V

VACUUM APPARATUS
Vacuum mechatronics N90-29854

VACUUM CHAMBERS
Vacuum mechatronics N90-29854

VACUUM MELTING
Realization of equipment for manufacturing titanium alloy electrodes for first step melting
[ONERA-RT-15/3578-M] N90-29498

VANADIUM ALLOYS
Swelling of neutron irradiated vanadium alloys
[DE90-015294] N90-29472

VAPOR DEPOSITION
Investigation of laser diagnostics of PACVO (Plasma Assisted Chemical Vapor Deposition) processes for depositing hard face coatings
[DE90-016209] N90-29522

VAPORIZING
Proceedings of a discussion meeting on Thermodynamics of Alloys
[AD-A224336] N90-29476

VARIABILITY
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143

VARIATIONAL PRINCIPLES
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437

VECTOR ANALYSIS
A vector diagram approach to shaping inputs for vibration reduction
[AD-A223724] N90-29671
Asymptotic code vector density in topographic vector quantisers
[RSRE-MEMO-4392] N90-30012

VECTOR SPACES
On equations of motion on complex Grassman manifold
[DE90-628369] N90-29999
VECTORS (MATHEMATICS)
Asymptotic code vector density in topographic vector quantisers
[RSRE-MEMO-4392] N90-30012
VELOCITY DISTRIBUTION
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
Calculation of turbulent air streams in driver cabs
[ETN-90-97320] N90-29310
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
VELOCITY MEASUREMENT
Measurement Techniques for Hypersonic Flows
[VKI-LS-1990-05] N90-29314
Velocity interferometry N90-29316
Laser velocimetry N90-29317
Electron beam for velocity determination N90-29319
VENTILATION
Calculation of turbulent air streams in driver cabs
[ETN-90-97320] N90-29310
VENUS (PLANET)
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146
VENUS ATMOSPHERE
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146
VERBAL COMMUNICATION
Instruction dialogues: Teaching new skills to a robot N90-29884
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
VERTICAL ORIENTATION
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767
VERY LARGE SCALE INTEGRATION
VLSI design for reliability
[AD-A224264] N90-29562
Macro cell placement with neural net algorithms
[REPT-90-020] N90-29585
A comparison of hardware implementations for low-level vision algorithms
[AD-A223699] N90-29945
VERY LOW FREQUENCIES
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves
[AD-A223685] N90-29738
VESTIBULES
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767
VHSIC (CIRCUITS)
A VHDL interface for Altera design files
[AD-A224476] N90-29920
VIBRATION
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424
Activities report of the Institute of Sound and Vibration Research
[ETN-90-97604] N90-30170
VIBRATION DAMPING
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
A vector diagram approach to shaping inputs for vibration reduction
[AD-A223724] N90-29671
Active vibration damping of flexible structures
[DLR-FB-90-03] N90-29676
Capture of free-flying payloads with flexible space manipulators N90-29784
VIBRATION EFFECTS
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
VIBRATION MEASUREMENT
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
VIBRATION TESTS
A human factors engineering approach to the development and dynamic evaluation of a prototype aircrew seat for military aircraft
[AD-A218283] N90-29779
VIBRATIONAL STRESS
Evaluation of plane-of-light noninterference stress measurement systems for measuring bladed disk vibrations
[AD-A223487] N90-29667
VINYL COPOLYMERS
Rheology of filler rubber: Silica-silicone
[AD-A223600] N90-29511
VISCOELASTICITY
A viscoelastic material model for computing stresses in glass
[DE90-014851] N90-29673
VISCOSITY
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619
VISCOUS FLOW
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1046] N90-29326
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE)
[NAL-TR-1028] N90-29330
VISCOUS FLUIDS
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619
VISUAL PERCEPTION
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29828
Recognition by linear combination of models
[AD-A224268] N90-29929
VISUAL STIMULI
Terrain visual cue analysis for simulating low-level flight: A multidimensional scaling approach
[AD-A223564] N90-29407
VLASOV EQUATIONS
Propagation of chaos and the McKean-Vlasov equation in duals of nuclear spaces
[AD-A224431] N90-30039
VOICE COMMUNICATION
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
VOICE DATA PROCESSING
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124
VOIDS
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
VOLT-AMPERE CHARACTERISTICS
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29466
VORTEX GENERATORS
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
VORTICES
Dynamic separation: Search for the cause of dynamic stall and search for its control
[AD-A223412] N90-29305
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
An additive turbulent decomposition of the Navier-Stokes equations implemented on highly parallel computer systems
[AD-A223678] N90-29595
The experimental investigation of flow in the core of a vortex structure
[BR114893] N90-29597
Investigation of fluid dynamic performance of LE-7 liquid oxygen pump
[NAL-TR-1020] N90-29650
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031
VORTICITY EQUATIONS
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301

W

WAFERS
A single wafer bit-sliced convolver: An optimum statistical solution for the implementation of redundancy
[REPT-89-019] N90-29584
Innovative techniques for the production of low cost 2D laser diode arrays
[AD-A223575] N90-29632
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration
[AD-A223812] N90-29953
WAKES
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
WALL FLOW
A numerical study of the response of the laminar unsteady separated flow about a circular cylinder to changes of boundary conditions
[DLR-FB-90-10] N90-29613
WALL JETS
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
Secondary flow in presence of wall jets: Incorporation of compression effects in a quasi-elliptic Navier-Stokes calculation code
[ETN-90-97559] N90-29602
WALL PRESSURE
Spectral measurements of the wall shear stress and wall pressure in a turbulent boundary layer: Theory
[AD-A224070] N90-29586
WALLS
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
WARFARE
Ring laser gyro principles and techniques N90-29352
WARNING SYSTEMS
Oxygen deficiency monitor system
[DE90-014866] N90-29917
WASTE UTILIZATION
Production of jet fuels from coal-derived liquids. Volume 13: Evaluation of storage and thermal stability of jet fuels derived from coal liquids
[AD-A224576] N90-29527
WATER
Shear-resistant drag reduction polymers. Part 1: Molecular investigations of polymer drag reduction and the development of laboratory screening methods
[AD-A223353] N90-29508
WATER POLLUTION
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712
WATER QUALITY
Shear-resistant drag reduction polymers. Part 1: Molecular investigations of polymer drag reduction and the development of laboratory screening methods
[AD-A223353] N90-29508
WATER TUNNEL TESTS
The experimental investigation of flow in the core of a vortex structure
[BR114893] N90-29597
WATER VAPOR
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
WATER WAVES
Research in nonlinear water waves
[AD-A224065] N90-29759
WAVE AMPLIFICATION
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596

WAVE ATTENUATION
Evaluation of a thermistor power measurement system for use on the NPL antenna extrapolation range
[NPL-DES-89] N90-29583
WAVE DISPERSION
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571
Experimental observations of nonlinear effects in laser-plasma interactions
[DE90-015195] N90-30079
WAVE FUNCTIONS
Effect of retardation on the reflectance properties of the metallic Fibonacci quasi-superlattice
[DE90-627316] N90-30091
Gaussons and states with gaussian Wigner functions are quasi-free states
[DE90-628370] N90-30121
WAVE INTERACTION
Theoretical study of the interaction between an oblique shock wave and a turbulent boundary layer from a heated wall
[ONERA-RSF-87/7078/AY-100-A] N90-29313
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327
WAVE PROPAGATION
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed
[AD-A223446] N90-29549
Specification for a standard electromagnetic propagation model
[AD-A223556] N90-29551
Research into traveling wave control in flexible structures
[AD-A224504] N90-29661
Regional phase propagation in three dimensionally heterogeneous media
[AD-A223279] N90-29731
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves
[AD-A223685] N90-29738
Elastic interfaces
[REPT-90-003] N90-29742
The effect of wave data assimilation on the numerical simulation of wave energy advection
[KNMI-TR-121] N90-29760
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033
Polarization correction of Luneburg lens with chiral medium
[PB90-189127] N90-30046
Experimental observations of nonlinear effects in laser-plasma interactions
[DE90-015195] N90-30079
WAVE SCATTERING
Regional phase propagation in three dimensionally heterogeneous media
[AD-A223279] N90-29731
Elastic interfaces
[REPT-90-003] N90-29742
WAVEGUIDE ANTENNAS
Evaluation of a thermistor power measurement system for use on the NPL antenna extrapolation range
[NPL-DES-89] N90-29583
WAVEGUIDES
Radar clutter via ray methods
[AD-A223796] N90-29553
Reliability study of TWT output RF window
[AD-A223688] N90-29574
Laser physics and laser spectroscopy
[AD-A224379] N90-29628
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033
Planar waveguide spectrometer
[DE90-016306] N90-30057
WAVELENGTH DIVISION MULTIPLEXING
Evaluation of a potential Wave Division Multiplexer (WDM) for use in the IRSTD
[AD-A223945] N90-29560
WEAR
The friction and wear of lubricated Si3N4/SiC(w) composites
[DE90-015790] N90-29448
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
Solid particle erosion in turbulent flows past tube banks
[DE90-015711] N90-29598
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
WEAR RESISTANCE
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
WEATHER
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747
WEATHER FORECASTING
The effect of wave data assimilation on the numerical simulation of wave energy advection
[KNMI-TR-121] N90-29760
WEIGHTLESSNESS
Renal response to seven days of lower body positive pressure in the squirrel monkey
[NASA-CR-183355] N90-29761
WELDED JOINTS
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
WELDED STRUCTURES
Issues in expanding the software base management system supporting the Computer Aided Prototyping System (CAPS)
[AD-A224344] N90-29933
WELDING
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
A welding metallurgy study of Hastelloy Alloys B-2 and W
[DE90-011910] N90-29481
An effective low-profile thermite torch
[DE90-015746] N90-29534
WHISTLERS
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
WIDTH
Adaptive control of an arc welding process
[AD-A223626] N90-29645
WIGNER COEFFICIENT
Gaussons and states with gaussian Wigner functions are quasi-free states
[DE90-628370] N90-30121
WIND (METEOROLOGY)
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691
Observations of tornadoes and wall clouds with a portable FM-CW Doppler radar: 1989--1990 results
[DE90-013152] N90-29752
WIND EFFECTS
Research in nonlinear water waves
[AD-A224065] N90-29759
WIND MEASUREMENT
Observations of tornadoes and wall clouds with a portable FM-CW Doppler radar: 1989--1990 results
[DE90-013152] N90-29752
Detection and analysis of wind fronts and current shear in digital SAR images
[FFI-89/7016] N90-29755
WIND PROFILES
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29716
WIND SHEAR
Geophysical turbulence research at NCAR
[AD-A223361] N90-29732
Windshear estimation along the trajectory of an aircraft N90-29745
Detection and analysis of wind fronts and current shear in digital SAR images
[FFI-89/7016] N90-29755
WIND TUNNEL MODELS
Thermographic phosphor technique N90-29324
WIND TUNNEL TESTS
Comparison of wind tunnel airfoil performance data with wind turbine blade data
[DE90-000343] N90-29308
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721
WIND TUNNELS
Comparison of wind tunnel airfoil performance data with wind turbine blade data
[DE90-000343] N90-29308
Studies of surface heat transfer in an arc-heated wind tunnel
[NAL-TR-1048] N90-29410
WIND TURBINES
Comparison of wind tunnel airfoil performance data with wind turbine blade data
[DE90-000343] N90-29308
WIND VARIATIONS
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724
WIND VELOCITY
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146
WIND VELOCITY MEASUREMENT
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29716
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146
WINDOWS (APERTURES)
Reliability study of TWT output RF window
[AD-A223688] N90-29574
WING OSCILLATIONS
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385
WING PLANFORMS
The experimental investigation of flow in the core of a vortex structure
[BR114893] N90-29597
WINGS
WingDesign: Program for the structural design of a wing cross-section
[LR-627] N90-29390
WINTER
Coping strategies and mood during cold weather training
[AD-A223915] N90-29773
WORK
Investigation of a heat driven thermoacoustic prime mover
[AD-A223928] N90-29694
WORKLOADS (PSYCHOPHYSIOLOGY)
Physiological metrics of mental workload: A review of recent progress
[NASA-CR-187290] N90-29777
WORKSTATIONS
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768
Telerobotic workstation design aid N90-29805
The telerobot workstation testbed for the shuttle aft flight deck: A project plan for integrating human factors into system design N90-29887
Supporting large scale applications on networks of workstations
[NASA-CR-186346] N90-29975
WORLD DATA CENTERS
The worldwide ionospheric data base
[NASA-TM-101823] N90-29714

X

X RAY IMAGERY
Soft x ray contact imaging of biological specimens using a laser-produced plasma as an x ray source
[DE90-016098] N90-30082
X RAY SOURCES
An x ray source for lithography
[AD-D014596] N90-29630
Soft x ray contact imaging of biological specimens using a laser-produced plasma as an x ray source
[DE90-016098] N90-30082
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164
X RAY SPECTROSCOPY
Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484

Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099
X RAY TELESCOPES
XMM space telescope: Development plan for the lightweight replicated x ray gratings
[DE90-015620] N90-30055
X RAYS
A tandem system of ionization chambers for effective energy determination of unknown X-radiation fields
[DE90-630463] N90-29405
Effect of retardation on the reflectance properties of the metallic Fibonacci quasi-superlattice
[DE90-627316] N90-30091
Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143

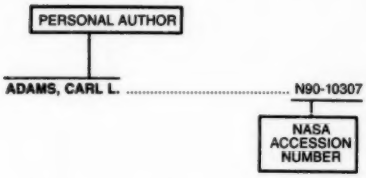
Y

YIELD STRENGTH
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
YTTRIUM COMPOUNDS
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108
YTTRIUM OXIDES
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat
N90-30088
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102

Z

ZEEMAN EFFECT
Lectures in plasma diagnostics
[DE90-015825] N90-30086
Interstellar magnetic fields: An observational perspective N90-30144
ZINC SELENIDES
The II-VI semiconductor superlattices
[AD-A223748] N90-30101
ZIRCONIUM ALLOYS
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
ZIRCONIUM OXIDES
Effect of environment upon mechanical behavior of structural ceramics for application in the DOE ceramic technology for advanced heat engines project
[DE90-014770] N90-29500
Non-destructive evaluation of infiltration-toughened ceramics
[DE90-629716] N90-29501
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520
ZONAL FLOW (METEOROLOGY)
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29718
ZONAL HARMONICS
Satellite motion in an axi-symmetric gravitational field. Part 1: Perturbations due to J2 (second order) and J3
[RAE-TR-88068] N90-29429

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

A

AAMODT, R. E. N90-30080
ABHIRAMAN, A. S. N90-29503
ACAR, LEVENT N90-29620
ACKERMAN, PHILLIP L. N90-29776
ADAIR, J. H. N90-29668
N90-29669
ADZIC, R. N90-29693
AFUWAPE, ANTHONY UYI N90-29991
N90-29992
AGRAWAL, AKHIL N90-30130
AHN, B. T. N90-30108
AHRENS, THOMAS J. N90-29505
AKASAKA, HIROMI N90-30068
AKASOFU, S. I. N90-29741
AKIMOTO, TOSHIO N90-29330
N90-29410
AKLONIS, JOHN J. N90-29514
ALANKO, T. N90-29923
ALAOUI, AMINE MOUNIR N90-29907
ALBERT, J. H. N90-29798
ALBERTS, THOMAS E. N90-29873
ALBUS, J. N90-29638
ALEXANDER, M. D. N90-29431
ALLARD, R. N90-29852
ALLEN, D. L. N90-29953
ALLEN, J. D., JR. N90-29656
ALLEN, M. G. N90-29323
ALLEN, S. M. N90-29482
N90-29483
ALONSO, JOSE LUIS N90-30150
AMIS, ERIC J. N90-29514
ANDARY, J. F. N90-29822
ANDERSON, D. H. N90-30048
ANDERSON, P. B. N90-29726
ANDERSON, R. P. N90-29527
ANDRADE, M. C. R. N90-30076
ANDRE, ANTHONY D. N90-30133
ANDRENUCCI, M. N90-29841
ANDRESEN, PETER N90-29322
ANHEIER, N. C. N90-30057
ANTONSEN, T. M., JR. N90-29633
APPELHANS, ANTHONY DAVID N90-29452
ARAI, HIROHIKO N90-29796
ARAI, NORIO N90-29331
ARANGUREN, MIRTA I. N90-29511
N90-29512
ARBOCZ, J. N90-29685
ARD, NELSON C. N90-29928
ARENDALE, WILLIAM F. N90-29430
ARIMOTO, SUGURU N90-29807
ARLOTTI, M. A. N90-29859
ARMANDROFF, TAFT EMERSON N90-30145
ARNAL, D. N90-29600
ARNOLD, KEVIN J. N90-29526
ARORA, O. P. N90-30098
ARTZ, R. S. N90-29747
ASAI, KEISUKE N90-29327
ASHFORD, N. J. N90-29334
ASHLEY, C. S. N90-29698
ASKUE, CECILIA ANN N90-29719
ASSINK, ROGER A. N90-29521
ATAIIYAN, YOUNES N90-29571
ATHERTON, C. S. N90-29709
ATKINSON, D. P. N90-30055
AUTRAN, JEAN-PHILIPPE N90-29459
AXELRAD, PENINA N90-29345
AYLWARD, D. M. N90-29573

B

BABCOCK, S. M. N90-29869
N90-29870
BACHMANN, H. N90-29427
BACKES, PAUL N90-29892
BADDOUR, R. F. N90-29513
BAEDER, JAMES DOUGLAS N90-30031
BAILEY, J. M. N90-29579
BAKULIN, V. L. N90-29597
BALANIS, CONSTANTINE A. N90-29539
BALDIS, H. A. N90-30079
BALDO, P. M. N90-29518
BALLARD, DANA H. N90-29908
BALLENTHIN, JOHN O. N90-29749
BALS, JOHANN N90-29676
BANKS, STEVEN N90-29942
BAO, CHAO-YING N90-29791
BARBACCI, MARIO R. N90-29950
BARBERO, EVER J. N90-29659
BARBIERI, ENRIQUE N90-29879
BARCLAY, REBECCA O. N90-30132
BARNUM, THOMAS J. N90-29618
BARON, B. N. N90-29697
BARRON, DON N90-29890
BASHKIN, STANLEY N90-30040
BASINSKA-LEWIN, E. M. N90-29726
BASRI, RONEN N90-29929
BASS, B. R. N90-29672
BASTON, W. D. N90-29428
BASU, SUNANDA N90-29723
BATES, J. L. N90-30104
BATTRICK, S. N90-29968
BAYO, EDUARDO N90-29878
BAYOUMI, M. M. N90-29852
BEAHAN, JOHN J., JR. N90-29810
BEAUCHAMP, PHILIP PAUL N90-29301
BECKER, JEFFREY M. N90-29906
BECKERMAN, M. N90-29649
BECKMAN, THOMAS M. N90-29529
BEDOYA, CARLOS A. N90-29341
N90-29363
BEECH, P. N90-29427
BEGEAL, DAVID R. N90-29534
BEJCZY, A. K. N90-29842
N90-29845
BEKEY, GEORGE A. N90-29788
BELIEEN, H. N90-29791
BELINSKI, STEVEN E. N90-29854
BELIYIANNIS, ANGELOS N90-29403
BENAY, R. N90-29313
BENFORD, GREGORY N90-30065
BENI, GERARDO N90-29854
BERCEANU, S. N90-29999
BERENS, A. P. N90-29500
BERGAMASCO, M. N90-29841
BERNARD, PETER S. N90-29588
BEYERS, R. N90-30108
BHALLA, A. S. N90-29668
N90-29669
BHAT, ISHWARA B. N90-29474
BIANCHINI, M. N90-29847
BIBL, KLAUS N90-29727
BIDWELL, S. N90-29633
BIEG, LOTHAR F. N90-29642
BIGGERS, KLAUS B. N90-29856
BILITZA, DIETER N90-29714
BINNING, R. C., JR. N90-29460
BIRKAN, M. A. N90-29432
BIRKMIRE, R. W. N90-29697
BIRMAN, KENNETH P. N90-29922
N90-29975
N90-29976
N90-29977
BIRX, DANIEL N90-29561
BLADOS, WALTER R. N90-30132
BLASS, J. J. N90-29491
BLATHERWICK, R. D. N90-29728
BLAU, P. J. N90-29647
BLOEM, O. J. N90-29535
BLOM, A. F. N90-29675
BLUESTEIN, H. B. N90-29752
BOATMAN, J. F. N90-29747
BOBROW, J. E. N90-29815
BOCK, K. D. N90-29427
BOISSIERE, PETER T. N90-29689
BOL, A. I. N90-29536
BOLAND, TIM N90-30127
BOLLER, D. J. N90-30115
BOLLINI, C. G. N90-30038
BON, BRUCE N90-29809
BOND, G. M. N90-29505
BONTEMPS, C. N90-29497
BOOK, WAYNE J. N90-29782
N90-29785
BOOKER, J. R. N90-29739
BOORSMA, DANIEL K. N90-29885
BOOSKE, J. H. N90-29633
BORGERS, H. J. N90-29558
BORGHETTI, JOHN F. N90-29749
BORLAND, R. E. N90-29971
BOSLEY, D. L. N90-30007
BOUCON, T. N90-29918
BOULOS, Z. N90-29764
BOUTIER, A. N90-29317
BOYER, JOSEPH H. N90-29631
BRACKIN, STEPHEN H. N90-29943
BRADSHAW, J. S. N90-29453
BRAISTED, PAUL N90-29343
BRATTON, THOMAS N90-29937
BRINDLE, A. F. N90-29798
BRINKER, C. J. N90-29698
BRINKER, C. JEFFREY N90-29521
BRISTOW, JULIAN N90-29931
BROWN, ALISON K. N90-29339
BROWN, H. L. N90-29478
BROWN, NORMAN J. N90-29533
BROWN, WADE W. N90-29487
BRYANT, CLIFFORD N90-29723
BUDENSKE, JOHN N90-29868
BUECHLER, DAVID N90-29340
BUETEFISCH, K.-A. N90-29319
N90-29320
BUIA, P. N90-29427
BULLETT, TERENCE W. N90-29727
BUNNELL, CHARLES T. N90-29877
BURGERS, GERRIT N90-29760
BURKE, T. C. N90-29524
BURKE, W. R. N90-29428
BURKHALTER, P. G. N90-30099
BURMESTER, C. P. N90-30108
BUSBY, R. W. N90-29722
BUSCH, D. E. N90-29516
N90-29518
BUSCHMANN, MICHAEL D. N90-29765
BUSSEY, ROBERT M. N90-29725
BUTLER, CARROLL N90-29307
BUTLER, P. L. N90-29869
BUTLER, RICKY W. N90-29965
BUTNER, STEVE N90-29814
BUTTERFIELD, C. P. N90-29308
BUTTON, P. N90-29428
BUTTRAM, MALCOLM T. N90-29578
BUXTON, J. R. N90-30011
BYER, ROBERT L. N90-29628
BYRNE, C. F. N90-30100
BYRNE, KEVIN N90-29403
BYUN, K. W. N90-29425

C

CABO, ALEJANDRO N90-30116
CAHEN, GEORGE L., JR. N90-29515
CALDAS, I. L. N90-30075
N90-30076
CALDAS, LINDA V. E. N90-29405
CALDWELL, JAMES L. N90-29965

CALDWELL, JO L. N90-29918
CAMARGO, S. J. N90-30076
CAMBANIS, STAMATIS N90-30021
CAMERON, WINIFRED S. N90-30148
CAMERON, WINIFRED SAWTELL N90-29415
CAMPBELL, PERRY N90-29857
N90-29890
CAMPBELL, V. W. N90-29579
CAMPIOTTI, RICHARD H. N90-29641
CANNON, PAUL S. N90-29727
CANNON, ROBERT H., JR. N90-29812
N90-29898
CARAM, RUBENS N90-29470
CARDENAS, R. N90-29473
CARESS, DAVID WILLIAM N90-29757
CARIGNAN, C. N90-29793
CARLOMAGNO, G. M. N90-29325
CARMEL, Y. N90-29633
CARON, P. N90-29497
CARPENTER, M. S. N90-29696
CARTER, EDWARD L. N90-29911
CARTER, RONALD L. N90-29571
CASELEY, P. J. N90-29427
CASTANEDA, PEDRO PONTE N90-29439
CATHEY, WADE THOMAS N90-30051
CATLIN, DONALD E. N90-29373
CATTO, P. J. N90-30080
CATTOLICA, ROBERT J. N90-29318
CATTON, IVAN N90-29595
CAVES, R. E. N90-29334
CAVESTRO, PAOLO N90-29792
CHABOCHE, J. L. N90-29677
CHAKAVEH, SEPIDEH N90-30159
CHAMBERS, ROBERT S. N90-29673
CHAN, TONY F. C. N90-29595
CHANDRASEKARAN, B. N90-29817
N90-29904
CHANG, CHI-YANG N90-29570
CHANG, JEFFREY N90-29636
CHAPEL, JIM D. N90-29840
CHAPMAN, J. M. N90-29423
CHAPOTON, CHARLES W. N90-29363
CHASE, MELISSA P. N90-29986
CHASE, R. N90-29918
CHATTOPADHYAY, ADITI N90-29383
CHAVE, A. D. N90-29739
CHEN, J. N90-29661
CHEN, NANQIAN N90-29613
CHENG, LAP Y. N90-29599
CHENG, P. C. N90-30082
CHERMAHINI, R. G. N90-29675
CHIACCHIO, P. N90-29813
CHIANG, SHIH-CHIEH N90-29799
CHIANG, T. S. N90-30039
CHIAVERINI, S. N90-29813
CHICARRO, A. N90-30141
CHICK, L. A. N90-30104
CHIN, KAN-PING N90-29829
CHINZEI, NOBUO N90-29397
N90-29398
CHIU, Y. DANNY N90-29383
CHOI, LING-SIU N90-29506
CHUANG, H. L. N90-29696
CHUN, HON N90-29826
CHURCH, E. L. N90-30058
CHURCHILL, SUSANNE N90-29761
CHYOU, HUI-HUANG ABEL N90-29437
CIESLAK, M. J. N90-29481
CIFTCIOGLU, MUHSIN N90-29520
CLARK, D. N90-29883
COFER, SUE N90-29825
COHEN, M. N90-29634
COHEN, R. E. N90-29513
COLEMAN, N. N90-29643
COLEMAN, P. N90-29622
COLEMAN, THOMAS F. N90-29959
COLLINS, J. J. N90-29622
COLOMBA, M. N90-29806
CONNOLLY, KRISTEN N90-29381
CONRAD, JOHN R. N90-29506
CONWAY, LYNN N90-29794
COOK, J. N90-29443
COOK, R. E. N90-29359
COONS, RUSS N90-30158
COOPER, ROBERT N90-29975
CORIELL, S. R. N90-30089
CORKER, K. N90-29805
CORNUM, RHONDA L. N90-29916
COSTANTINE, ALFRED G. N90-30163
COSTELLO, H. M. N90-29869
COUGHENOUR, M. B. N90-29710
COUMES, THOMAS M. N90-29594
COX, C. S. N90-29739
COZZENS, ROBERT F. N90-30053
CRAIG, K. N90-29643
CRAIG, KEVIN C. N90-29942
CRAMER, H. N90-29805
CRANE, CARL D., III N90-29799
CRANGLE, COLLEEN N90-29884
CRAWFORD, D. R. N90-29394
CREEL, E. E. N90-29375
CRESCENTI, GENNARO H. N90-29748
CROSS, L. E. N90-29668
N90-29669
CROUCH, PETER N90-29925
CROWLEY, GEOFFREY N90-29727
CROWLEY, W. P. N90-29989
CSERNICA, J. N90-29513
CUBBAGE, SAM N90-30158

D

DAFROTAMATTOS, MARCOS ANDRE N90-29743
DAHL, DAVID ADRIAN N90-29452
DAHMEN, U. N90-30103
DALLMAN, PETER KARL N90-30047
DAMAREN, C. J. N90-29860
DANKERT, C. N90-29319
DAREJEH, H. N90-29622
DARIO, P. N90-29841
DAS, HARI N90-29829
DAS, S. K. N90-29449
DASGUPTA, A. N90-29573
DAUD, ABDEL-KARIM N90-29580
DAVID, VALERIE N90-29419
N90-30142
DAVIS, CLARK C. N90-29856
DAVIS, LARRY P. N90-29695
DAVIS, S. J. N90-29323
DAVIS, W. A. N90-29571
DEASON, VANCE A. N90-29652
DEDERICHS, P. H. N90-29494
DEFACIO, BRIAN N90-29540
DEGROOT, J. S. N90-30081
DEHAAN, LAURENS N90-30019
DEHON, ANDRE N90-29978
DEJONG, W. G. N90-29380
N90-29409
DEJONGH, F. H. C. N90-29772
DELASHERAS, MIRIAM N90-29760
DELEUTERIO, G. M. T. N90-29860
DELMORE, JAMES EDWARD N90-29452
DELOREY, DENNIS E. N90-30129
DELPECH, MICHEL N90-29832
DEMELENNE, B. N90-29428
DEMMEL, J. N90-29683
DEMMEL, JOHANN N90-29692
N90-29753
DEONIGI, D. E. N90-30139
DEPEUTER, W. N90-29844
DERBYSHIRE, K. R. N90-29428
DESA, LUIZ AUGUSTO DISCHER N90-29720
DESSE, J. M. N90-30061
DESTLER, W. W. N90-29633
DEVLIN, GARY L. N90-29917
DEVORE, C. E. N90-29448
DEWILDE, J. P. N90-29433
DIESEL, JOHN W. N90-29347
DIJKSTRA, F. N90-29433
DIMARTINO, V. N90-29859
DINER, DANIEL B. N90-29827
DIPIPPO, S. N90-29846
DIPPOLITO, D. A. N90-30080
DIVITO, BEN L. N90-29965
DIX, G. E. N90-29573
DIX, RICHARD E. N90-29307
DOBBINS, JAMES C. N90-29648
DODD, C. V. N90-29656
DOHERTY, PATRICIA N90-29723
DOMINGO, V. N90-30141
DOMINIC, ROBERT J. N90-29667
DONER, WILLIAM D. N90-29593
DONNELLAN, M. E. N90-29443
DONOHUE, MARC D. N90-29467
DONOVAN, BRIAN J. N90-30129
DORK, RONALD A. N90-29376
DOSSER, LARRY R. N90-29530
DOUBLEDAY, DENNIS L. N90-29950
DOUGHERTY, J. P. N90-29668
N90-29669
DOVI, AUGUSTINE R. N90-29384
DOYAMA, M. N90-29494
DRAKE, PAUL N90-30081
DREETZ, EKKEHARD N90-29581
DRISCOLL, C. F. N90-30077
DRITTLER, B. N90-29494
DRUFUCA, GIUSEPPE N90-29742
DUBACH, J. F. N90-30042
DUBEY, R. V. N90-29870
DUBOWSKY, S. N90-29871
DUCASTELLE, F. N90-29497
DUDAS, CHARLES N90-29937
DUFFY, JOSEPH N90-29799
DUFFY, P. N90-30147

E

EAGAR, T. W. N90-29482
EAGER, T. W. N90-29483
EATON, D. N90-29427
EBNER, ROBERT E. N90-29362
EDWARDS, D. F. N90-30055
EDWARDS, TIM N90-29525
EFIMOV, G. V. N90-30119
EISEMAN, PETER R. N90-29608
N90-29609
N90-29610
EL-ARINI, M. B. N90-29365
EL-DESSOUKI, M. S. N90-30092
EL-GUIZIRI, S. B. N90-30092
ELANDS, P. J. M. N90-29433
ELLEFSON, R. E. N90-29698
ELLIS, KENNETH K. N90-29406
ELLIS, STEPHEN R. N90-29828
ELMER, J. W. N90-29482
N90-29483
ELTON, STEPHEN D. N90-29550
EMBURY, J. F. N90-30048
ENDO, SHUJI N90-29614
ENDOH, MASANORI N90-29687
ENGLUND, C. E. N90-29771
EPPERSON, S. J. N90-29674
ERCK, R. A. N90-29516
N90-29517
N90-29518
ERDEMIR, A. N90-29516
N90-29518
ERICKSON, J. D. N90-29912
ESCHENBACK, RALPH N90-29343
ESLAMI, MANSOUR N90-29693
ESTABROOK, K. N90-30081
ESTEP, ROBERT J. N90-29956
EULER, J. A. N90-29870
EVANS, ALYSON N90-29336
EVANS, ANTHONY G. N90-29440
N90-29441
EWICK, D. W. N90-29635
EWICK, DAVID W. N90-29529

F

FABER, VANCE N90-29924
FAKLIS, DEAN N90-30049
FAROUK, B. N90-29587
FARRARA, JOHN DAMON N90-29715
FARRELL, JAMES L. N90-29372
FAUGERAS, O. D. N90-29802
FEDDEMA, JOHN T. N90-29801
FEDERICO, GENNARO S. N90-29749
FEDYANIN, V. K. N90-29473
FELDMAN, MICHAEL B. N90-29949
FELDMAN, U. N90-29634
FELLERHOFF, J. R. N90-29375
FENG, WEI-GUO N90-30090
N90-30091
FENN, ALAN J. N90-29548
FENSKE, G. R. N90-29516
N90-29517
N90-29518
FERNAN, PAUL THOMAS N90-29560
FERRAND, PASCAL N90-29602
FERRIGNO, JANE G. N90-29691
FESTOU, MICHEL C. N90-30157
FIALA, JOHN N90-29823
N90-29984
FICKIE, KURT D. N90-29589
FIDELL, S. A. N90-30035
FIJANY, AMIR N90-29864
FINNEGAN, S. A. N90-29431
FIORINI, PAOLO N90-29839
FITCH, J. PATRICK N90-29957
FJAEREIDE, HERMOD N90-29349
FLYNN, MIKE N90-29381
FORSTER, PETE N90-29818
FOSS, MICHAEL N90-29340
FOUCAT, G. N90-29604
FOWLER, KENNETH J. N90-29379
FOX, MARK S. N90-29816
FOYLE, DAVID C. N90-29913
FRANK, MARK N90-29539
FRANKE, RICHARD N90-30015
FRASIER, SCOTT M. N90-29554
FREYMUTH, PETER N90-29305
FRIC, THOMAS FRANK N90-29591
FRIED, W. R. N90-29357

FRIEDLAND, BERNARD N90-29361
FRIEDMAN, INGER P. N90-29424
FRIES, R. JAY N90-29778
FRIESKE, H. J. N90-29528
FRISCH, HAROLD P. N90-29826
FRISK, U. O. N90-30141
FU, C. Y. N90-29674
FUECHSEL, CHARLES F. N90-29781
FUJIMORI, YOSHINORI N90-29422
FUKUDA, MASAHIRO N90-29326
FULLER-ROWELL, TIMOTHY J. N90-29734

G

GAIFULLIN, A. M. N90-29597
GALLAGHER, RANDY N90-29381
GAMBLE, ED N90-29945
GANG, JIN N90-29467
GARNER, F. A. N90-29472
N90-29484
N90-29485
N90-29495
N90-29496
GARRARD, G. D. N90-29395
GARRY, W. J. N90-29573
GATZA, PAUL E. N90-29504
GAVRIILIDIS, JOSEPH N90-29403
GEDDES, ROBERT L. N90-29373
GENTLE, D. G. N90-29583
GEORGE, E. P. N90-29490
GEORGE, JOHN S. N90-29958
GERSH, M. E. N90-29542
GERVASIO, D. N90-29693
GHALLAB, MALIK N90-29907
GHANDHI, C. N90-29475
GHANDHI, SORAB K. N90-29474
GHEORGHE, A. N90-29999
GHOSH, A. K. N90-29475
GIAMBIAGI, J. J. N90-30038
GILL, J. T. N90-29698
GINI, MARIA N90-29868
GINSBERG, MARK D. N90-29531
GLASCO, D. B. N90-29953
GLASS, S. J. N90-29501
GLASSELL, R. L. N90-29869
GLATT, L. N90-29394
GLENDENNING, NORMAN K. N90-30155
GLICKSMAN, M. E. N90-30089
GLUZBAND, YEHEZKIEL A. N90-29765
GOATES, STEVEN R. N90-29485
GOBRIAL, F. Z. N90-30092
GOETZ, GUENTER N90-29556
N90-29557
GOETZINGER, J. W. N90-29527
GOLD, RONALD R. N90-29424
GOLDMAN, A. N90-29728
GOLDMAN, D. S. N90-30057
GOLDSTEIN, JEFFREY JAY N90-30148
GOLDSTEIN, W. N90-30147
GOLDSTEIN, W. H. N90-29634
GONZALEZ, ARMANDO N90-29507
GOODING, R. H. N90-29429
GOODMAN, ALYSSA ANN N90-30144
GOODMAN, DENNIS M. N90-29957
GOODRICH, S. N90-29500
GOODSON, EARL F., SR. N90-29480
GORETTA, KENNETH C. N90-30109
GORSUCH, THOMAS E. N90-29479
GOTO, SOSUKE N90-29421
GOULD, S. S. N90-30135
GRAHAM, J. SCOTT N90-29346
GRANATSTEIN, V. L. N90-29633
GRANT, D. N90-29500
GRAVES, G. A. N90-29500
GRAVES, PHILIP L. N90-29783
GRAY, HENRY F. N90-29569
GREEK, CHRIS N90-29381
GREEN, J. B. N90-29527
GREENSPAN, M. E. N90-29726
GREGORY, RUTH N90-30041
GRIFFIN, R. D. N90-29496
GRIGSBY, R. D. N90-29527
GRODZINSKY, ALAN J. N90-29765
GRONDIN, ROBERT O. N90-29567
GRONSKY, R. N90-30108
GRONSKY, RON N90-30105
GROSSMAN, ROBERT N90-29925
GRUBER, P. L. N90-29739
GRUNWALD, ARTHUR N90-29828
GRYNOVICKI, JOCK O. N90-30020
GUEDRY, F. E. N90-29767
GUENTHER, ALEX BRIAN N90-29721
GUER, T. M. N90-30108
GUNJI, S. N90-30164
GUNSHOR, ROBERT L. N90-30101
GUNTER, R. L. N90-29747
GUO, RENLI N90-30008
GUPTA, RADHA R. N90-29368
N90-29369
GUPTA, SHANTI S. N90-30006

H

HACKWOOD, SUSAN N90-29854
HAESSIG, DAVID, JR. N90-29351
HAFIZI, BAHMAN N90-29630
HAGANS, K. G. N90-30056
HAGGAG, FAHMY M. N90-29493
HAHN, HONG T. N90-29445
HAIRSTON, M. R. N90-29733
HAJJ, IBRAHIM N. N90-29562
HALCOMB, DANNY L. N90-29534
HALL, RONALD C. N90-30136
HALLAUER, W. L. N90-29424
HAMAGUCHI, YASUMASA N90-29499
HAMILTON, M. L. N90-29485
N90-29495
HAN, KWANG S. N90-30064
HAN, YOUN-SIK N90-29850
HANDLER, ROBERT A. N90-29588
HANKS, R. L. N90-29577
HARADA, KOICHI N90-29974
HARIMA, MITSUHIRO N90-29857
HARLAN, DON L. N90-29882
HARRIGAN, RAYMOND W. N90-29889
HARRINGTON, ROGER F. N90-29568
HARRIS, D. G. N90-29374
HARRIS, J. M. N90-29747
HARRIS, NEIL RICHARD PETER N90-29703
HARRISON, F. WALLACE N90-29872
HART, L. W. N90-29739
HASEGAWA, SATOSHI N90-29650
HATCH, J. A. N90-29621
HATFIELD, DONALD W. N90-29565
HATFIELD, WILLIAM E. N90-29444
HATTAN, C. P. N90-29551
HAUG, EDWARD J. N90-29826
HAUSER, G. C. N90-30134
HAWKYARD, A. N90-29427
HAWSEY, R. A. N90-29579
HAYASHI, TAKAYA N90-30071
HAYATI, SAMAD N90-29809
N90-29892
HAYHURST, KELLY J. N90-30014
HAYS, CLIFFORD O., JR. N90-29934
HEACOCK, J. G. N90-29739
HEALEY, K. J. N90-29912
HEATH, M. T. N90-29960
HECHT, N. L. N90-29500
HEEL, JOACHIM N90-29985
HEELIS, R. A. N90-29733
HELLER, M. V. A. P. N90-30075
HELWEG-LARSEN, M. N90-30035
HENDERSON, DANIEL EDWARD N90-29645
HENNESSEY, MICHAEL P. N90-29877
HERDEN, ANDREAS F. W. N90-30059
HERMAN, M. N90-29638
HERNDON, J. N. N90-29869
N90-29870
HERVIG, KJELL N90-29349
HESS, C. W. N90-29912
HETRICK, D. M. N90-29674
HEWITT, D. R. N90-29822
HICHO, G. E. N90-29471
HICKS, R. S. N90-30042
HICKS, ROBERT J. N90-29388
HIGGINS, CHRISTOPHER N90-29403
HILDEBRAND, V. E. N90-29738
HILL, CHRISTOPHER J. N90-29876
HILLS, C. R. N90-29481
HILLS, H. KENT N90-29414
HILTON, S. N90-29500
HINKAL, S. W. N90-29822
HIRAI, SHIGEOKI N90-29888
HIRATA, HIDETOSHI N90-29400
HIRATA, K. S. N90-30160
HIROSE, NAOKI N90-29326
N90-29327
N90-29332
HIRSCHLER-MARCHAND, PATRICK R. N90-29547
HIRZINGER, G. N90-29842
HO, PAULINE N90-29463
HOCHEID, B. N90-29646
HOENIG, THOMAS N90-30112
HOENIGMAN, J. R. N90-29500
HOFFMAN, RICHARD G. N90-29769
HOFFMANN, ALEX N90-29403
HOFFMANN, HANS-EBERHARD N90-29692
N90-29753
HOGENDOORN, R. A. N90-29969
HOL, J. M. A. M. N90-29685
HOLDER, D. A. N90-29963
HOLLINS, R. C. N90-29636
HOLYER, R. J. N90-29941
HOMENDEMELLO, L. S. N90-29866
HOMMA, KOHZO N90-29625
HONG, J. N90-29883
HONG, WEI-WANG N90-30090
HOPPING, KENNETH A. N90-29876
HOPWOOD, JAMES E. N90-29641
HOROWITZ, RICHARD N90-29416
N90-30140
N90-30148
HORST, HERBERT N90-29753
HORWEDEL, B. M. N90-29712
HOUGHTON, F. KAY N90-29778
HOURCADE, M. N90-29646
HU, R. N90-29518
HUANG, ALLEN HUNG-LUNG N90-29716
HUANG, PAUL C. N90-29877
HUBBARD, ARTHUR T. N90-29458
HUBER, M. C. E. N90-30142
HUCKA, MICHAEL N90-29619
HUDLICKA, E. N90-29605
HUG, G. N90-29497
HUG, KARLHEINZ N90-29982
HUGGINS, R. A. N90-30108
HUMPHREY, JOSEPH A. C. N90-29598
HUNG, STEPHEN H. Y. N90-29803
HUNT, ANTHONY J. N90-29545
HUNT, JAMES N90-30169
HUNTON, DONALD E. N90-29707
N90-29749
HUSKINS, JAMES M. N90-29933
HUTCHINGS, L. A. N90-30035
HUTCHINSON, I. H. N90-30086
HUTTON, JOHN T. N90-29493
HWANG, JAMES N90-29890
HYLIN, E. C. N90-29595

I

IATRIDIS, J. C. N90-29837
IBERALL, THEA N90-29788
ICHIKAWA, SHIN-ICHIRO N90-29421
ICHIKAWA, Y. H. N90-30069
N90-30070
IEZZI, GABRIELLE N90-30158
IIKURA, S. N90-29784
IKAWA, KATSUYA N90-29327
IMAI, RYOICHI N90-29899
INOUE, SEIICHI N90-29829
INOUE, YASUTOSHI N90-29422
ISHIKAWA, KAZUTOSHI N90-29391
ISHIKAWA, YASUYUKI N90-29460
ITOH, SANAE-I N90-30072
ITOH, TATSUO N90-29570
IWATA, TSUTOMU N90-29899
IYENGAR, SATISH N90-30027
IZATT, R. M. N90-29453

J

JACKSON, CHRISTIAN N90-30050
JACKSON, DOUGLAS E. N90-29996
JACKSON, JOHN E. N90-29690
N90-30140
N90-30148
JACOBSEN, STEPHEN C. N90-29856
JAIN, ABHINANDAN N90-29894
JAJODIA, SUSHIL N90-30130
JAKEMAN, E. N90-29636
JAKOBSEN, P. N90-30141
JAMES, J. H. N90-29726
JAMISON, KEITH A. N90-29418
JANSEN, E. L. N90-30013
JANSSEN, JAN ERNST N90-29310
JAU, BRUNO M. N90-29838
JEKELI, CHRISTOPHER N90-29735
JENKIN, G. T. N90-30100
JENKINS, DAVID H. N90-29388
JENKINS, LYLE M. N90-29895
JENNINGS, T. A. N90-29573
JEWELL, WILLIAM S. N90-29653
JHA, L. N. N90-30063
JOHANSSON, ERIK M. N90-29957
JOHNESCU, J. R. N90-30034
JOHNSON, D. N90-29739
JOHNSON, D. D. N90-30111
JOHNSON, JOHN A. N90-29652
JOHNSON, TODD R. N90-29904
JOHNSON, W. STEVEN N90-29450
JONES, B. A. N90-30078
JONES, WILLIAM D. N90-29489

JORDAN, CAROLYN E. N90-29737
JORDAN, D. L. N90-29636
JORDAN, STEVE N90-29814
JOSEPH, THOMAS A. N90-29976
N90-29977
JOSEPHSON, JOHN R. N90-29851
JUILLEN, J. C. N90-29600
JUNGBLUTH, WERNER N90-29624

K

KAHL, W. K. N90-29579
KAHNEMAN, DANIEL N90-29774
KAILASANATH, K. N90-29587
KAJITA, T. N90-30160
KAK, A. C. N90-29930
KAKUTA, YOSHIAKI N90-29499
N90-29686
KALLIANPUR, G. N90-30039
KAMAE, T. N90-30184
N90-30185
KAMIJO, KENJIRO N90-29650
KAMIMURA, T. N90-30069
N90-30070
N90-30073
KAMMAN, J. W. N90-29644
KAN, EDWIN N90-29892
KANAMURA, K. N90-29693
KANDA, TAKESHI N90-29397
N90-29396
KANE, M. J. N90-30062
KANFER, RUTH N90-29776
KANMURI, AKIO N90-29397
N90-29398
KANOU, OSAMU N90-29447
KANT, K. N90-30131
KARIOTIS, R. N90-30094
KARP, PETER D. N90-29987
KARPEL, MORDECHAY N90-29385
KAUFMAN, LLOYD N90-29775
KAWAI, NOBUHIRO N90-29326
N90-29328
KAWAMATA, YOUICHI N90-30058
KAWANISHI, H. N90-29495
KAY, BRUCE D. N90-29521
KEANE, DECLAN N90-30037
KEENEY-WALKER, J. N90-29672
KEITH, WILLIAM L. N90-29586
KELLEHER, DENNIS L. N90-29773
KELLEY, M. C. N90-29724
KELLEY, ROBERT B. N90-29867
KENNEDY, IAN M. N90-29590
KENNEDY, JOHN M. N90-30132
KENNETT, BRIAN L. N90-29731
KERR, ROBERT M. N90-29732
KERSTEN, P. R. N90-29930
KESHAVARZI, A. N90-29696
KESKINEN, J. N90-29923
KESKKULA, H. N90-29502
KESSLER, M. F. N90-30141
KEVORKIAN, J. N90-30007
KHAN, T. N90-29497
KIBE, SEISHIROU N90-29422
KIFUNE, T. N90-30160
KIHARA, K. N90-30160
KIKUNO, EIJI N90-29326
KILGORE, MELVIN V., JR. N90-29430
KILKENNY, J. D. N90-29577
KILMER, R. N90-29638
KIM, DAI-SIK N90-30106
N90-30107
KIM, HYUNGSU N90-29502
KIM, J. K. N90-30064
KIM, OH-KIL N90-29508
KIM, S. Y. N90-30069
KIM, SANG J. N90-29413
KIM, SUNG-SOO N90-29626
KIM, W. S. N90-29845
KIMURA, TOYOAKI N90-30068
KING, JOSEPH H. N90-29416
N90-30149
KITTEL, T. N90-29710
KIVETT, J. A. N90-29359
KIVETT, JAMES A. N90-29358
KLAPISCH, M. N90-29634
KLAPISH, M. N90-30147
KLAUSMEIER-BROWN, M. E. N90-29696
KLEIN, A. DAVID N90-29362
KLEIN, WILLIAM N90-29438
KLEISS, JAMES A. N90-29407
KLEMM, R. A. N90-30110
KLEMRADT, U. N90-29494
KLINGENBERG, G. N90-29528
KLINGMANN, J. L. N90-30055
KNIGHT, TOM N90-29978
KNOBBE, EDWARD J. N90-29367
KNOPS, H. A. J. N90-29678
KNORR, JEFFREY B. N90-29584
KNOTT, K. N90-30141
KNOWLES, P. N90-30100
KNUDSEN, D. J. N90-29724
KO, SUNG HOON N90-29951
KOBAYASHI, H. N90-29865
KOCH, A. N90-29320
KOCH, TAD H. N90-29627
KOGAN, BORIS N90-30130
KOLAR, DAVID W. N90-29773
KOLLMANN, WOLFGANG N90-29590
KOMATSU, T. N90-29784
KOMERATH, N. M. N90-29304
KONINGSTEIN, ROSS N90-29898
KORDES, F. L. G. N90-29969
KORTING, P. A. O. G. N90-29433
KOSHIISHI, HAJIME N90-29625
KOSHINUMA, TAKESHI N90-29687
KOSMATKA, J. B. N90-29394
KOZIER, K. S. N90-29559
KOZLOWSKI, MARC N90-29381
KRAMER, ARTHUR F. N90-29777
KRAMER, DANIEL P. N90-29529
KRESS, R. L. N90-29669
KREUTZ, KENNETH N90-29811
N90-29894
KROGMANN, P. N90-29320
KRZENSK, UDO N90-30022
KUBAN, D. P. N90-29790
N90-29869
KURIHARA, KENICHI N90-30068
KUTVONEN, P. N90-29923
KUZAN, JOHN D. N90-29589

L

LABINI, G. SYLOS N90-29846
LABURTHE, F. N90-29600
LACOTE, C. N90-29603
LAFFERRIERE, GERARDO N90-29883
LAGALLY, M. G. N90-29456
N90-30094
LAHTI, PAUL M. N90-29435
N90-29461
N90-29509
N90-29510
LAI, JUNBIAO N90-29679
LAIRD, JOHN E. N90-29819
LAMB, J. D. N90-29453
LANDES, J. D. N90-29672
LANDON, MARK D. N90-29954
LANDSTRASS, MAURICE I. N90-29576
LANG, PATRICIA M. N90-29701
LANGE, FRIEDRICH N90-29967
LANGER, A. W. N90-29771
LARSEN, R. J. N90-29711
LARSON, D. C. N90-29674
LARSON, RICHARD N90-29925
LASERRE, SYLVIE N90-29584
LATHAM, P. E. N90-29633
LAW, C. K. N90-29455
LAWRENCE, TAYLOR W. N90-29957
LEADBETTER, M. R. N90-30019
LEAKE, C. H. N90-29771
LEBOEUF, FRANCIS N90-29602
LEBRETON, J. P. N90-30141
LECA, P. N90-29983
LEE, C. S. G. N90-29801
LEE, JA H. N90-30064
LEE, L. C. N90-29741
LEE, MILTON L. N90-29465
LEE, R. N90-29516
LEE, R. H. N90-29518
LEE, S. C. N90-30154
LEE, S. M. N90-30064
LEE, THOMAS N90-29832
LEE, THOMAS S. N90-29892
LEE, V. Y. N90-30108
LEE, WOON YUNG N90-29378
LEE, YOUNG-WOOK N90-30152
LEERTOUWER, K. N90-29427
LEFEBVRE, M. N90-29312
LEGGETT, P. J. N90-29428
LEINONEN, M. S. N90-29662
LEISTER, KAREN J. N90-30014
LEKOUDIS, S. G. N90-29432
LEONARD, L. E. N90-29698
LEONDES, C. T. N90-29338
LEVUSH, B. N90-29633
LEWERENTZ, BIRGITTA N90-29537
LEWIS, DAVID H. N90-29853
LIAO, YUNING N90-30006
LIEFER, RANDALL K. N90-29389
LIEN, D. J. N90-30153
LIENERT, T. J. N90-29481
LIN, HSIAO-TSENG N90-29694
LIN, JONG-YIH N90-29639
LINDELL, I. V. N90-30046
LINDEMAN, PHILIP A. N90-30028
LINDEMANN, RANDEL N90-29836
LING, M. R. N90-29680
N90-29681
LITTMAN, DAVID CARL N90-29927
LITWIN, TODD N90-29804
N90-29809
LIU, C. T. N90-29490
LIU, G. N90-29505
LIU, HUAN N90-29788
LIU, JINN-LIAN N90-29997
LIVINGS, JEFFREY N90-29937
LLOYD, J. N90-29892
LOEBEL, HEINZ N90-29753
LOEHE, JOSEPH R. N90-29457
LOEHNER, RAINALD N90-29309
LOEWENSTEIN, GEORGE N90-29350
LOISEAU, A. N90-29497
LOKSHIN, ANATOLE N90-29804
LONGDON, NORMAN N90-30168
N90-30169
LOOMIS, B. A. N90-29472
LOUIS-MARTINEZ, DOMINGO N90-30116
LOULA, ABIMAEL F. D. N90-29592
LOVELLETTE, MICHAEL NEWMAN N90-30088
LOWDER, DOUGLAS MAYNARD N90-30161
LU, QIU-JIANG N90-29717
LUCAS, THOMAS A. N90-29654
LUDU, ANDREI N90-30074
LUMIA, R. N90-29638
LUMIA, RONALD N90-29823
N90-29891
N90-29984
LUNDSTROM, M. S. N90-29696
LUO, REN C. N90-29650
LUSH, G. B. N90-29696
LUTON, J. N. N90-29579
LUTTRELL, STEPHEN P. N90-30012

M

MACEDO, MARIO N90-29403
MACFARLANE, R. E. N90-29674
MACK, B. N90-29852
MACKENZIE, EILEEN N90-29723
MACOSKO, CHRISTOPHER W. N90-29511
N90-29512
MADALA, R. V. N90-29750
MAEDA, TARO N90-29796
MAGNANI, P. G. N90-29806
MAGNANI, PIERGIOVANNI N90-29903
MAGNESS, R. B. N90-29870
MAHNKOPF, REINHARD N90-30114
MAILFERT, J. N90-29603
MAIOCCHI, R. N90-29972
MAKO, FREDERICK N90-29630
MALMBERG, J. H. N90-30077
MANE, L. N90-29983
MANGASER, AMANTE N90-29814
MANGIACAPRE, THOMAS P. N90-29515
MANHEIMER, WALLACE M. N90-29572
MANNSTEIN, HERMANN N90-29754
MARAWA, AMOS N90-29403
MARCE, LIONEL N90-29905
MARCHAND, J.-L. N90-29969
MARCO, DAVID N90-29902
MARKOPOULOS, MARINOS P. N90-30033
MAROON, GARY N. N90-29383
MAROTZ, JOERG N90-30060
MARRISON, CLAIRE N90-29336
MARSDEN, R. N90-30141
MARSDEN, R. G. N90-29427
MARTIN, GRAHAM J. N90-29352
MARTIN, RUSSELL C. N90-29701
MARTINEZ, S. D. N90-29375
MARZULLO, KEITH N90-29922
MASARIE, KEN A. N90-29701
MASON, MATTHEW T. N90-29848
MASRY, ELIAS N90-30021
MASSATT, P. N90-29348
MASUTANI, YASUHIRO N90-29807
MASUYA, GORO N90-29397
N90-29398
MATHEW, T. N90-29595
MATHEWS, G. J. N90-30044
MATHIAS, LON J. N90-29459
MATSUDA, YUKIO N90-29687
MATSUMOTO, KOTARO N90-29422
MATSUZAKI, RI-ICHI N90-29410
MATSUZAKI, TAKASHI N90-29410

MATTICE, M. N90-29643
MATTICE, MICHAEL N90-29942
MAUTZ, JOSEPH R. N90-29568
MAYERGOYZ, I. D. N90-29633
MAYO, MERRILEA J. N90-29520
MCALLESTER, DAVID N90-30003
MCCAIN, HARRY G. N90-29821
MCCANDLESS, B. E. N90-29697
MCCARTER, OLIVER T. N90-29376
MCCARTHY, J. M. N90-29484
N90-29815
MCCLENAHAN, CHARLES R. N90-29578
MCCONNELL, B. W. N90-29579
MCCORD, JAMES W. N90-29952
MCCULLUM, D. E. N90-29500
MCDERMOTT, D. A. N90-29858
MCDONALD, BRIAN N90-29381
MCDONOUGH, J. M. N90-29595
MCEWAN, T. E. N90-29577
MCFADDEN, G. B. N90-30089
MCFADIN, L. W. N90-29912
MCKAY, GORDON N90-29670
MCKENNA, MATT N90-29381
MCKNIGHT, TIMOTHY E. N90-29532
MCLAUGHLIN, J. S. N90-29881
MCMILLAN, J. C. N90-29377
MEHALLI, MAHMOUD N90-29403
MEHLMAN, G. N90-30099
MEHRABIAN, ROBERT N90-29440
N90-29441
MEIER, H. N90-29428
MEIJER, G. N90-29320
MELIUS, CARL F. N90-29463
MELLOCH, M. R. N90-29696
MELVIN, LELAND N90-29515
MENG, TERESA H.-Y. N90-29981
MERRILL, J. T. N90-29747
MERROW, MARK N90-30158
MEYERS, L. G. N90-29451
MEYERS, RAY J. N90-29955
MEYSTEL, ALEX N90-29900
MICHALOSKI, JOHN L. N90-29891
MIKKOLA, T. P. J. N90-29662
MILEY, G. H. N90-30084
MILEY, GEORGE H. N90-30085
MILLER, M. D. N90-29477
MILLS, GERALD MICHAEL N90-29702
MINATO, MASAKI N90-29435
MINSKY, HENRY N90-29978
MIRICK, ROBERT ALLEN N90-29619
MISKIMEN, R. A. N90-30042
MITCHELL, O. R. N90-29801
MIURA, H. N90-29784
MIYABA, HOROSHI N90-29410
MIYAKAWA, YUKIO N90-29651
MIYAZAKI, FUMIO N90-29807
MIYAZAKI, S. N90-30164
MIZUNO, KATSU N90-30081
MO, Y. W. N90-29456
N90-30094
MODARELLI, DAVID A. N90-29435
MODDEL, GARRET N90-30051
MODROW, MARLAN B. N90-29565
MOHANTY, A. P. N90-29470
MOHLER, JONATHAN H. N90-29534
MOLLEY, POLLY A. N90-30054
MOLTO, MAVIS BERTHA N90-30125
MOLVIG, KIM N90-29980
MONTESANTI, R. C. N90-30055
MONTGOMERY, D. S. N90-29621
MOOIJEKIND, J. C. M. N90-29380
N90-29409
MOORE-EDE, M. C. N90-29764
MOORE-EDE, MARTIN C. N90-29761
MOORE, N. L. N90-30139
MORA, ELSI N90-29511
N90-29512
MOREHOUSE, JEFFREY H. N90-29637
MORGAN, J. M. N90-29696
MORGAN, K. N90-29611
MORINO, LUIGI N90-29386
MORLOCK, ULRICH N90-30113
MORRIS, PETER B. N90-29368
N90-29369
MORRIS, R. A. N90-29478
MORRISON, H. F. N90-29739
MORROW, THOMAS H. N90-29408
MOSSA, MARTIN N90-29654
MOSSMAN, CHARLES A. N90-29532
MOYER, DALE N90-29576
MUIR, HELEN N90-29336
MUKHERJEE, RANJAN N90-29797
MURCRAY, D. G. N90-29728
MURCRAY, F. H. N90-29728
MURCRAY, F. J. N90-29728
MUROTA, K. N90-29402
MUROTA, KATSUICHI N90-29626
MURPHY, WILLIAM J. N90-29363
MURRAY, B. T. N90-30089
MURRAY, WALTER N90-29932
MUSIAL, WALT N90-29308
MUTKA, M. N90-29923
MYRA, J. R. N90-30080

N

NAGAYASU, MASAHIKO N90-29399
NAGPURWALA, Q. H. N90-29926
NAIMAN, DOUGLAS Q. N90-29467
NAITOH, PAUL N90-29770
NAJM, FARID N. N90-29562
NAKA, MASAO N90-29422
N90-29625
NAKAHASHI, KAZUHIRO N90-29326
NAKAHATA, M. N90-30160
NAKAMURA, K. N90-30160
NAKAMURA, YOSHIHIKO N90-29797
NANSTAD, RANDY K. N90-29493
NASSER, M. G. N90-29962
NATALE, MARY ELLEN N90-29761
NAVA, E. J. N90-29375
NEAGLE, BRAD D. N90-29406
NEGRI, M. N90-29973
NESTOR, J. N90-29921
NEUBAUER, RUDOLF N90-29624
NEUMANN, W. E. N90-29428
NEVATIA, R. N90-29940
NEWMAN, D. A. N90-30099
NEWNHAM, R. E. N90-29668
N90-29669
NEWTON, PAUL K. N90-30001
NG, CAROLYN N90-30123
NGUYEN, AN H. N90-29800
NGUYEN, MARC H. N90-30158
NGUYEN, T. C. N90-29644
NICHOLS, F. A. N90-29518
NISHIMURA, J. N90-30164
NISHIMURA, MAKOTO N90-29651
N90-29657
NITTA, KEIJI N90-29422
NOETZOLD, DIRK N90-29556
N90-29557
NOGAMI, J. N90-30095
NOGUCHI, YOSHIO N90-29436
NOMURA, Y. N90-30069
N90-30070
NORMAN, J. N90-29767
NUSCA, MICHAEL J. N90-29303
NUTT, K. W. N90-29324
NUTTER, JEROME PAUL N90-29920

O

OBRIEN, MAUREEN N90-29825
ODA, MITSUSHIGE N90-29899
OGAWA, SATORU N90-29331
OHARA, JOHN N90-29808
OHARA, S. N90-30160
OHTSUBO, KOJI N90-29422
OKA, TAKESHI N90-30066
OKADA, A. N90-29485
OKAWA, U. S. N90-29358
OLIVERO, JOHN J. N90-29736
OLLENDORF, STANFORD N90-29824
OMALLEY, MARTIN W. N90-29578
ONEIL, T. M. N90-30077
ONO, FUMIEI N90-29434
ONO, TAKATSUGU N90-29391
OPPENHEIM, IRVING J. N90-29786
N90-29833
ORAN, E. S. N90-29587
OTSUKA, NOBUO N90-30101
OULD, PETER C. N90-29346
OUTKA, DAVID E. N90-29426
OWENS, JOHN M. N90-29571
OZGUNER, UMIT N90-29820
N90-29879

P

PACHECO, FERNANDO E. N90-29787
PADILLA, JUAN N90-29444
PALARZ, HOWARD M. N90-30158
PAN, S. K. N90-29477
PANTANO, CARLO G. N90-29507
PAPPERT, R. A. N90-29553
PARHI, N. N90-29993
PARIKH, PARESH N90-29309
PARIS, D. T. N90-29538
PARKINSON, BRADFORD W. N90-29345
PARKINSON, ETIENNE N90-29602
PARSONS, CAROLYN M. N90-30129
PARTHASARATHY, R. N90-29414
PARTON, W. N90-29710
PARZEN, EMANUEL N90-30017
N90-30018
PASQUARIELLO, G. N90-29846
PATE, J. R. N90-29656
PATEL, D. N90-30100
PAUL, D. R. N90-29502
PAUL, R. P. N90-29865
PAUTONNIER, F. N90-29498
PAVIE, FLORENCE N90-29311
PAVLATH, G. A. N90-29353
PAVLOPOULOS, THEODORE G. N90-29631
PAYNE, RICHARD E. N90-29748
PAZAK, MICHAEL G. N90-30122
PEACOCK, A. N90-30141
PEALAT, M. N90-29312
PEARCE, R. P. N90-29751
PECHT, M. G. N90-29573
PEDERSEN, A. N90-30142
PEGNEAUX, J. C. N90-30061
PEIRO, J. N90-29611
PELAGATTI, G. N90-29973
PENNER, J. E. N90-29709
PENSKI, ELWIN C. N90-29454
PERAIRE, J. N90-29611
PERDZOCK, JOHN M. N90-29341
PERNICI, B. N90-29972
PERRYMAN, M. A. C. N90-30141
PETERKIN, ROBERT E., JR. N90-30067
PETERS, ALEXANDER N90-29961
PETERSON, G. A. N90-30042
PETROSKY, LYMAN J. N90-29833
PHANOS, JOHN N90-29350
PHARES, W. J. N90-29395
PHILLIPS, ALAN H. N90-29351
PHILLIPS, J. E. N90-29697
PHINNEY, DALE E. N90-29912
PIELKE, R. A. N90-29710
PIERRET, R. F. N90-29696
PINDER, GEORGE F. N90-29961
PINEAU, S. N90-29846
PINELLI, THOMAS E. N90-30132
PING, YANG N90-29562
PINSKI, F. J. N90-30111
PIRZADEH, SHAHYAR N90-29309
PLACE, PATRICK R. H. N90-30005
PLATT, IAN G. N90-29729
POLITZER, IEVA R. N90-29631
POLLOCK, DAVID M. N90-29761
POLLOCK, W. D. N90-29450
POMMEL, FREDERIC N90-29602
POPHIN, DANNY RAYMOND N90-29746
PORTER, ROGER S. N90-29459
POURBOGHRAT, F. N90-29831
POWELL, DOUGLAS G. N90-29459
POWELL, FREDERICK D. N90-29938
PRAMANIK, S. N90-29979
PRASANNA-KUMAR, V. K. N90-29940
PREWETT, A. N90-29636
PREWO, KARL M. N90-29448
PRICE, CHARLES N90-29855
PRICE, CHARLES R. N90-29875
N90-29876
N90-29890
PRINGLE, J. K. N90-29431
PRIOR, J. N90-29621
PRIOR, J. A. N90-29620
PROPER, G. J. N90-29623
PRUNEAU, PAUL N. N90-30129

Q

QI, DONG-MEI N90-29392
QUATE, C. F. N90-30095
QUINTERO, R. N90-29638
QUONG, S. N90-30108

R

RADACK, D. J. N90-29633
RADER, C. M. N90-29953
RADMILOVIC, V. N90-29449
RAMMOHAN, K. N90-29926
RANDJBAR-DAEMI, S. N90-30120
RANKEN, DOUGLAS M. N90-29958
RAO, A. S. N90-30098
RAO, K. N. N90-29457
RAPA, J. S. N90-29573
RASH, CLARENCE E. N90-29916
RAVICHANDRAN, A. N90-30131
RAZAQ, A. N90-29693

RAZAQ, M. N90-29693
REDDINGIUS, NICHOLAAS H. N90-30036
REE, MALCOLM JAMES N90-29996
REED, S. T. N90-29698
REED, WILMER H., III N90-29424
REES, DAVID N90-29734
REESE, WILHELM N90-29401
REHN, L. E. N90-29518
REIN, D. H. N90-29513
REINISCH, BODO W. N90-29727
REINLEITNER, LEE A. N90-29725
N90-29730
REMUZZI, CLINTON C. N90-29355
RENSCHLER, C. L. N90-29698
REPKO, MICHAEL C. N90-29867
REUTER, G. J. N90-29912
REYNAERTS, D. N90-29789
RHEINBOLDT, WERNER C. N90-29997
RHOADES, D. E. N90-29912
RHODES, C. G. N90-29475
RHODES, WILLIAM J. N90-29706
RHODUS, W. N90-29348
RICE, JAMES R. N90-29670
RICH, PAUL M. N90-29958
RICHARDS, J. B. N90-29620
RICHMAN, JACK N90-29361
RICHTSMEIER, S. C. N90-29542
RICKER, D. W. N90-30034
RINEHART, LARRY F. N90-29578
RIPIN, B. H. N90-30099
RISH, EDWARD C. N90-29350
ROBERT, GILLES N90-29601
ROBINO, C. V. N90-29481
ROCCI, PETER J. N90-29574
ROCKSTROH, H. N90-29528
RODRIGUESPACHECO, RICARDO N90-29403
RODRIGUEZ, G. N90-29894
RODRIGUEZ, GUILLERMO N90-29780
N90-29830
N90-29874
ROESCH, WILFRIED N90-30043
ROGERS, RON N90-29370
ROLPH, G. D. N90-29747
ROMAN, WARD C. N90-29522
ROOT, J. H. N90-29501
ROOTZEN, HOLGER N90-30019
ROSEBOROUGH, JAMES B. N90-29829
ROSENAU, T. J. N90-29979
ROSINGER, H. E. N90-29559
ROSITTO, FRANK C. N90-29435
ROSS, M. L. N90-29858
ROSS, MICHAEL N90-29910
ROSS, MIKE N90-29890
ROSS, P. N. N90-29699
ROSS, PATRICIA A. N90-29416
ROSSITTO, FRANK C. N90-29510
ROSSOW, CORD-CHRISTIAN N90-29605
ROTHWELL, A. N90-29390
ROVETTA, A. N90-29847
ROVETTA, ALBERTO N90-29792
ROWE, J. C. N90-29869
ROWE, NEIL C. N90-29853
ROY, G. S. N90-29432
RUDNICK, K. N90-29348
RUPERT, A. N90-29767
RUSSELL, D. A. N90-30080
RUSSELL, L. C. N90-29417
RUTTEN, ERIC N90-29905
RYERSON, D. E. N90-30134

S

SAEED, MOHAMED N90-29403
SAFFARIAN, M. H. N90-29699
SAFFMAN, PHILIP G. N90-29759
SAGNES, P. N90-29604
SAKAMOTO, HIROSHI N90-29434
SAKATA, SHINYA N90-30068
SALES, GARY S. N90-29729
SALIBA, SUSAN S. N90-29367
SALKIND, L. N90-29883
SALTZMAN, JEFFREY S. N90-29924
SANDERSON, A. C. N90-29866
SANDERSON, C. G. N90-29711
SANKAR, L. J. N90-29306
SANKEY, O. F. N90-30093
SANTOSO, B. N90-29789
SANUKI, H. N90-30073
SARAVANAMUTTOO, H. I. H. N90-29393
SARGIS, P. D. N90-30056
SASA, SHUICHI N90-29399
N90-29412
SASAKI, MASAKI N90-29434
SASHEGYI, K. D. N90-29750
SATO, H. N90-30160
SATO, T. N90-29888
SATO, TETSUYA N90-30071
SAUERWEIN, TIMOTHY N90-29887
SAUNDERS, MICHAEL A. N90-29932
SAVAGE, D. E. N90-29456
SAWICKA, B. D. N90-29501
SBATTELLA, L. N90-29973
SCHAEFER, BERND E. N90-29843
SCHAFER, R. W. N90-29538
SCHEID, ROBERT E. N90-29864
SCHELL, F. M. N90-29656
SCHENKER, PAUL S. N90-29849
SCHIFFBAUER, WILLIAM H. N90-29901
SCHIJVE, J. N90-29679
N90-29680
N90-29681
N90-29682
N90-29683
N90-29684
SCHIPPER, J. D. N90-29582
SCHISTAD, ANNE HELENE N90-29755
SCHLEGEL, R. N90-29604
SCHLESSINGER, MONTE N90-29370
SCHMIDT, RODNEY A. N90-30051
SCHNEIDER, ALAN M. N90-29342
N90-29360
SCHNEIDER, STANLEY A. N90-29812
SCHNURR, RICHARD N90-29826
SCHNURR, RICK N90-29825
SCHOENTHAL, MARK N90-29937
SCHOFIELD, NORMAN J. N90-29414
SCHONBERG, E. N90-29921
SCHULTE, KENNETH J. N90-29445
SCHULTZ, MARTIN H. N90-29947
SCHULZ, J. C. N90-29431
SCHUSTER, JOACHIM N90-29892
SCHWARZ, R. K. N90-29963
SCHWENTERLY, S. W. N90-29579
SCIAVICCO, L. N90-29813
SCIOMACHEN, ANNA N90-29903
SCOTESE, ARTHUR E. N90-29442
SCOTT, GEORGE N. N90-29308
SCULLY, MARLAN O. N90-29617
SCUTARU, H. N90-30121
SECAN, JAMES A. N90-29725
N90-29730
SEERING, WARREN N90-29826
SEERING, WARREN P. N90-29880
SEIBT, DIETER N90-29766
SEIDL, R. H. N90-29573
SEJNOWSKI, TERRENCE N90-29552
SEKI, KATSUMI N90-29651
SEKIMOTO, Y. N90-30164
SEKIMURA, N. N90-29495
N90-29496
SEKINO, HIDEO N90-29460
SELCHOW, N. J. N90-30078
SELLAR, RICH N90-29381
SELLECK, M. E. N90-30089
SENSEMAN, DAVID M. N90-29768
SERAJI, HOMAYOUN N90-29780
N90-29830
N90-29832
N90-29874
SERNA, M. N90-29878
SETH, JAYSHREE N90-29470
SETHURAMAN, JAYARAM N90-30016
SEVERANCE, C. N90-29979
SHAH, MAYUR N90-29631
SHAHIN, M. Y. N90-29531
SHAIN, PAUL MARK N90-29466
SHAPIRO, ALBERT J. N90-29344
SHAPIRO, DANIEL G. N90-29897
SHAPIRO, PAUL S. N90-29706
SHARP, JOHN K. N90-30136
SHAW, GERALD L. N90-29735
SHEARON, ANDY N90-29381
SHEN, SHANFU N90-29613
SHEPODD, T. J. N90-29698
SHERIDAN, THOMAS B. N90-29829
SHETH, PRADIP N. N90-29942
SHIEKH, A. Y. N90-30154
SHIHO, TORU N90-29420
SHIMOKAWA, TOSHIYUKI N90-29499
N90-29686
SHIMOYAMA, I. N90-29784
SHIMOYAMA, ISAO N90-29786
SHINN, JOSEPH H. N90-29708
SHIPKOWSKI, MICHAEL S. N90-29919
SHIRAISHI, K. N90-30117
SICILIANO, B. N90-29813
SIEGL, J. N90-29684
SIEGMUND, P. C. N90-29713
SIHVOLA, A. H. N90-30048
SINCLAIR, M. N90-29771
SINGER, NEIL C. N90-29880
SINGHOSE, WILLIAM N90-29671
SIPCIC, SLOBODAN R. N90-29386
SIVATI, L. A. N90-30035
SKLAR, M. N90-29795
SKOWRONEK, C. N90-29443
SLEATOR, DANIEL D. N90-29944
SLINGSBY, PATRICIA L. N90-29549
SLIWA, R. N90-29969
SLUITER, M. N90-30111
SMARTT, H. B. N90-29478
SMEETS, G. N90-29315
N90-29316
SMITH, D. L. N90-29472
SMITH, ELIZABETH SZYSZKOWSKI N90-30126
SMITH, ERNEST E., JR. N90-29909
SMITH, J. H. N90-29471
SMITH, JACK W., JR. N90-29904
SMITH, L. M. N90-30100
SMITH, ROBERT D. N90-29299
SMOLIAR, S. N90-29921
SMYTH, JOHN S. N90-30036
SOHNS, C. W. N90-29579
SOLOWAY, DONALD I. N90-29873
SON, LE HUNG N90-29995
SOOD, DEEPAK N90-29867
SOONG, MOU-LING N90-29631
SORBY, KRISTIN N90-30105
SOTOZAKI, TOKUO N90-29411
SPIEKER, DAVID A. N90-29523
SPITZER, MIKE N90-30158
SPITZER, WILLIAM SETH N90-29758
SPRANGLE, PHILLIP N90-29630
SRINIVASAN, GANAPATHI R. N90-29302
STALKER, K. TERRY N90-30054
STANSBERY, EILEEN K. N90-29744
STARK, LAWRENCE N90-29800
STARK, MARGARET A. N90-29530
STARRFIELD, S. N90-30156
STASI, BILL N90-29808
STAUNTON, B. D. N90-29881
STEEL, DUNCAN G. N90-30096
STEELE, L. PAUL N90-29701
STEEPER, TIMOTHY J. N90-29616
STELLINGWERF, ROBERT F. N90-30067
STELLWAG, T. B. N90-29696
STEMPLE, ALAN DOUGLAS N90-29382
STEPHENS, ROBERT L. N90-29916
STEPHENSON, MICHAEL B. N90-29955
STERN, ROBERT A. N90-30143
STERNE, P. A. N90-30102
STEWART, JOSEPH N90-29578
STINE, L. R. N90-29356
STONE, J. N90-29371
STONER, GLENN E. N90-29515
STONESIFER, G. RICHARD N90-30123
STOREY, C. N90-30010
STORTI-GAJANI, GIANCARLO N90-29585
STRATHDEE, J. N90-30120
STUBBINS, J. F. N90-29495
STUNDER, B. J. B. N90-29747
STURM, G. P., JR. N90-29527
STURZA, MARK A. N90-29366
SUBRAMANYAN, V. R. N90-29356
SUGIYAMA, NANAHISA N90-29687
SULLIVAN, DONALD J. N90-30067
SULLIVAN, J. D. N90-29501
SUMNER, ARTHUR L. N90-29462
SUN, YI-CHUIN N90-29613
SUNDAR, P. N90-30039
SUNDAR, RAJAMANI N90-30002
SUNDARAM, KAMALA N90-29826
SUPPES, P. N90-29884
SURESH, DEIVARAJAN N90-29700
SUTHERLAND, IAN N90-29943
SUTTER, P. H. N90-29837
SUZUKI, MINEO N90-29657
SUZUKI, Y. N90-30160
SWAIN, RONALD L. N90-29493
SWAMINADHAM, M. N90-29396
SWAMINADHAM, MIDTURI N90-29667
SWARTZENTRUBER, B. S. N90-29456
N90-30094
SWEATT, WILLIAM C. N90-30054
SWIGART, R. J. N90-29394
SYKES, M. V. N90-30153
SYMPSON, WILLIAM GOEBEL, III N90-29948
SZAKALY, Z. N90-29845
SZOSTAK, ROSEMARIE N90-30105

T

TACHI, SUSUMU N90-29796
TAKACS, P. Z. N90-30058
TAKAGI, SHOHEI N90-29626
TAKAHASHI, MINORU N90-30068

TAKAHASHI, T. N90-30164
TAKANASHI, SUSUMU N90-29332
TAKEDA, KATSUMI N90-30030
TAKEI, AKIRA N90-30071
TAMURA, HIROSHI N90-29434
TAMURA, T. N90-30164
TAN, HUA N90-29505
TAN, X. N90-29883
TANABE, GIICHI N90-29333
TANAKA, M. N90-30164
TANEMURA, TOSHIHARU N90-29422
TARAN, JEAN-PIERRE N90-29321
TARANKO, E. N90-29473
TARANKO, R. N90-29473
TARJAN, ROBERT E. N90-29944
N90-30002
TARLE, GREGORY N90-30045
TAROKH, M. N90-29834
TARRANT, J. N90-29793
TATE, ATSUSHI N90-29329
TAYLOR, B. G. N90-30142
TAYLOR, DAVID KENT N90-30151
TAYLOR, EDITH C. N90-29910
TAYLOR, S. RAY N90-29515
TELSCHOW, KENNETH L. N90-29652
TERAZAWA, HIDEZUMI N90-29544
TESAR, DELBERT N90-29836
N90-29855
N90-29902
THAKOR, N. V. N90-29837
THANGARAJ, KANNAPPAN N90-29631
THEVENIN, P. N90-29498
THOMAS, BOSHAN N90-30130
THOMAS, DAVID L. N90-29493
THOMAS, G. N90-29449
THOMPSON, BRUCE N90-29826
THOMPSON, J. F. N90-29612
THOMPSON, RICHARD B. N90-29629
THURSTON, WILLIAM P. N90-29944
TIENARI, M. N90-29923
TILMANS, E. N90-29428
TIRYAKI, AYDIN N90-29990
N90-29994
TISHKOFF, J. M. N90-29432
TIWARI, ANIL N90-29343
TODOROKI, J. N90-30073
TOLEDO, ELSON MAGALHAES N90-29592
TOLOFARI, S. N90-29334
TORFASON, L. N90-29902
TORISAKI, TADAO N90-30030
TORRES, M. A. N90-29871
TORRES, WILLIAM R. N90-29936
TOTSUKA, Y. N90-30160
TREADWAY, WILLIAM K. N90-29446
TRINH, LU N90-30158
TROMEUR-DERVOUT, D. N90-29983
TRUSCOTT, P. R. N90-30162
N90-30166
TRZCINSKI, EDMUND N90-29749
TSO, KAM N90-29809
N90-29892
TSUKANO, YUKICHI N90-29391
TUCK, CHRISTOPHER M. N90-29819
TUDBALL, MIKE N90-30005
TUFTS, DONALD W. N90-30004
TUMEH, ZUHEIR S. N90-29835
TUMOK, N. NUR N90-29548
TUNCER, I. N90-29306
TURCHI, P. E. A. N90-30111
TURNER, JAMES N90-29826
TURNER, MICHAEL S. N90-29740
TURNIPSEED, G. N90-29767
TWIST, R. E. N90-29573
TZENG, CHING-YAW N90-29745
TZES, ANTHONY P. N90-29787

U

UDY, JERRY L. N90-29954
UEDA, T. N90-29402
UENOHARA, M. N90-29784
UKO, LIVINUS UGOCHUKWU N90-30023
N90-30024
ULAN, JUDITH G. N90-30105
ULLMAN, MARC N90-29898
ULLMAN, SHIMON N90-29929
UMETANI, YOJI N90-29896
UNRUH, W. P. N90-29752
URAS, RASIM AZIZ N90-29660

V

VACCARO, RICHARD J. N90-29566
VAILLANT, R. N90-29802
VALLADARES, CESAR N90-29723
VANBRUSSEL, H. N90-29789
N90-29791
VANCE, E. E. N90-29671
VANCLEEF, GARRETT WARREN, II N90-29718
VANDERHAVEN, J. N90-29623
VANDERHEIJDE, M. A. D. N90-29337
VANDERLINDEN, AD N90-30029
VANDERVEEN, G. N90-29360
VANWECHEL, ROBERT J. N90-29346
VARADAN, V. K. N90-29668
N90-29669
VARADAN, V. V. N90-29668
N90-29669
VARADARAJAN, V. N90-30084
VASSEL, A. N90-29498
VAVASIS, STEPHEN A. N90-29959
VECHESLAVOV, V. V. N90-30025
VEDULA, K. N90-29488
VENABLE, DEMETRIUS O. N90-30064
VENEMA, STEVEN C. N90-29827
VEYRAC, M. N90-29646
VICHNIAC, GERARD N90-29980
VICINO, RAYMOND N90-29966
VICKERS, ROSS R., JR. N90-29773
VICKREY, J. F. N90-29724
VIDDELEER, R. N90-29428
VIETS, KAREN J. N90-29364
VIGGH, H. E. M. N90-29798
VIITANEN, A. J. N90-30046
VINCK, HAN N90-30124
VITEK, V. N90-29492
VLASES, GEORGE C. N90-30087
VOCK, WILFRED N90-30009
VODRET, S. N90-29847
VOGES, H. N90-29320
VOIGT, ROBERT G. N90-29939
VOLZ, RICHARD N90-29794
VONFLOTOW, ANDREAS H. N90-29661
VONTHEUMER, ALFRED E. N90-29615
VORA, RAJUL N90-29799
VOSTREYS, ROBERT W. N90-29415
VUSKOVIC, MARKO I. N90-29863

W

WADA, YASUHIRO N90-29331
WAFFENSCHMIDT, E. N90-29844
WAKAIRO, KAORU N90-29412
WAKAMATSU, YOSHIO N90-29397
N90-29398
WAKEFIELD, K. A. N90-30135
WALKER, MICHAEL W. N90-29794
WALKER, R. G. N90-30153
WALKO, R. J. N90-29698
WALPOLE, DENNIS A. N90-30128
WALSH, SUSANNE B. N90-29655
WALTHER, JEANETTE A. N90-29531
WALTON, J. J. N90-29709
WANG, G. S. N90-29675
WANG, J. J. N90-29785
WANG, SUOJIN N90-30000
WANG, YULUN N90-29814
WARD, TEXAS M. N90-29882
WARREN, V. W. N90-29425
WATANABE, AKIRA N90-29412
WATANABE, MIKIO N90-29657
WATANABE, MINORU N90-30030
WATANABE, YASUO N90-29422
WATANABE, YOSHIAKI N90-29650
WEATHERILL, N. P. N90-29607
WEBB, M. B. N90-30094
WEBER, DIETER-JUERGEN N90-29468
WEBER, DONALD J. N90-29354
WEBER, GERALD J. N90-29578
WEBER, W. J. N90-30104
WEERASOORIYA, TUSIT N90-29663
WEGERIF, D. N90-29795
WEGNER, P. N90-29921
WEILAND, T. L. N90-29620
WEIMER, D. R. N90-29726
WEINBERGER, P. J. N90-29921
WEINERT, M. N90-29494
WEINSTOCK, CHARLES B. N90-29950
WELLER, ROBERT A. N90-29748
WELLS, W. J. E. N90-29970
WEN, JOHN T. N90-29811
WENZEL, K.-P. N90-29427
N90-30142
WESTMACOTT, K. H. N90-30103
WHEATLEY, THOMAS E. N90-29891
WHELAN, S. J. N90-29573
WHITE, ALLAN L. N90-30014
WHITE, JAMES M. N90-29924
WHITE, P. L. N90-30057
WHITEHEAD, STEVEN D. N90-29908
WHITELEY, JAMES DAVID N90-29779
WHITING, ELLIS E. N90-29300
WICKENS, CHRISTOPHER D. N90-30133
WIDERHOLD, G. N90-29921
WIE, B. N90-29425
WIJCHERS, T. N90-29433
WILCOX, BRIAN N90-29809
WILCOX, WILLIAM R. N90-29470
WILCZEK, FRANK N90-29740
WILKINS, DAVID C. N90-29935
N90-29987
WILLE, L. T. N90-30102
N90-30108
WILLIAMS, D. M. N90-29790
N90-29869
WILLIAMS, RICHARD S., JR. N90-29691
WILLIAMSON, SAMUEL J. N90-29775
WILLMAN, WARREN W. N90-29986
WILSON, DEBORAH JOANNE N90-29658
WITTENBERG, H. N90-29433
WITTMERS, L. E. N90-29769
WODARCZYK, FRANCIS J. N90-29695
WOLCOTT, P. N90-29921
WOLF, J. D. N90-29500
WOLFORD, LIONEL T. N90-29631
WOLFRUM, H. N90-29320
WONG, E. W. N90-29394
WOOD, C. E. C. N90-30097
WOOD, WILLIAM G. N90-30005
WOODS, ALPHONSO L. N90-30128
WOODWARD, C. E. N90-29953
WRENN, GREGORY A. N90-29384
WRIGHT, R. J. N90-30048
WU, XIANG N90-30090
N90-30091
WYATT, PHILIP J. N90-30050

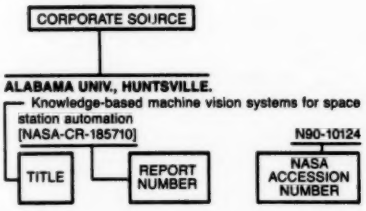
Y

YAE, K. HAROLD N90-29826
YAGER, ERIC S. N90-29819
YAJIMA, H. N90-30164
YAMADA, HITOSHI N90-29650
YAMAMOTO, HIROMICHI N90-29422
YAMAMOTO, HISASHI N90-30118
YAMAMOTO, YUKIMITSU N90-29330
YAMANE, KOSABURO N90-29411
YAMAOKA, N. N90-30164
YANAGIHARA, MASAAKI N90-29399
YANEY, P. N90-29500
YANG, TACHUNG N90-29640
YANG, WENBO N90-29505
YAO, HE-SHENG N90-30091
YEAGER, ERNEST B. N90-29693
YIANNAKOPOULOS, G. N90-30026
YOSHIDA, K. N90-30117
YOSHIDA, KAZUYA N90-29896
YOSHIDA, MAKOTO N90-29650
YOSHINAGA, TAKASHI N90-29329
YOUNG, D. N90-29805
YOUNG, P. E. N90-30079
YOUNG, PETER N90-30081
YOUNGBLOOD, G. E. N90-30104
YU, PETER Y. N90-30106
N90-30107
YUEN, CHUK-LAM N90-30032
YUN, X. N90-29865
YURKOVICH, STEPHEN N90-29787
YUST, C. S. N90-29448
N90-29519

Z

ZACH, ADOLF N90-29401
ZAHORCHAK, ROBERT J. N90-29430
ZANDBERGEN, B. T. C. N90-29433
ZANOLIN, FABIO N90-29992
ZEGLINSKI, DAVID MARK N90-29486
ZELLER, R. N90-29494
ZELTSER, M. J. N90-29365
ZHANG, XING N90-29679
ZHAO, FENG N90-29946
ZHUANG, MEI N90-29596
ZIELINSKI, ALEXANDER E. N90-29418
ZIMMERMAN, WAYNE N90-29886
ZOMACK, MICHAEL N90-29489
ZOONTJES, R. P. G. N90-29390

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACADEMY OF SCIENCES (USSR), NOVOSIBIRSK.
A canonical integration technique of arbitrary order
[DE90-628377] N90-30025

ADVANCED DECISION SYSTEMS, MOUNTAIN VIEW, CA.
The astronaut and the banana peel: An EVA retriever scenario N90-29897

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).
Analysis, Design and Synthesis Methods for Guidance and Control Systems
[AGARD-AG-314] N90-29338
Recommended practices for measurement of gas path pressures and temperatures for performance assessment of aircraft turbine engines and components
[AGARD-AR-245] N90-29393
Workshop on Low Level Flight Training
[AGARD-AR-288] N90-29404

AERONAUTICAL RESEARCH INST. OF SWEDEN, STOCKHOLM.
Comparison of crack closure result obtained by 3D elastic-plastic FEM and modified Dugdale model
[FFA-TN-1990-18] N90-29675

AEROSPACE CORP., EL SEGUNDO, CA.
The 2-D and 3-D characterizations of GPS navigation service N90-29348
Performance constraints and compensation for teleoperation with delay N90-29881

AEROSPACE CORP., LOS ANGELES, CA.
Pointing control system for the Teal Ruby experiment N90-29370

AIR FORCE ASTRONAUTICS LAB., EDWARDS AFB, CA.
Spectroscopy of propellant-related flames
[AD-A224068] N90-29525

AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MA.
Effects of thruster firings on the shuttle environment 1: Neutral gas composition
[AD-A224404] N90-29707
Proceedings of the 17th Annual Gravity Gradiometer Conference
[AD-A223568] N90-29735
Production of NO, NO2 and N2O in air by breakdown with high power microwaves: A preliminary report
[AD-A223297] N90-29749

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OH.
Integrating rule-based and neural-net techniques for spectral analysis
[AD-A223517] N90-29462
Analysis and design of modifications for improved performance of the AFIT radar cross section measurement chamber
[AD-A223352] N90-29545

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH, BOLLING AFB, WASHINGTON, DC.
AFOSR/ONR Contractors' Meeting on Combustion Rocket Propulsion Diagnostics of Reacting Flow
[AD-A224411] N90-29432
Proceedings of the High Energy Density Materials Contractors Conference
[AD-A223793] N90-29695

AIR FORCE WRIGHT AERONAUTICAL LABS., WRIGHT-PATTERSON AFB, OH.
A human factors engineering approach to the development and dynamic evaluation of a prototype aircrew seat for military aircraft
[AD-A218283] N90-29779

ALABAMA UNIV., HUNTSVILLE.
Definition of a near real time microbiological monitor for space vehicles
[NASA-CR-185599] N90-29430

ALASKA UNIV., FAIRBANKS.
A study of magnetic field reconnection and plasma processes in the magnetosphere
[DE90-016117] N90-29741

ALLIED-SIGNAL AEROSPACE CO., KANSAS CITY, MO.
Thermal analysis of bismaleimide matrix resins
[DE90-016283] N90-29523

ANALYTIC SCIENCES CORP., READING, MA.
Overview of Omega signal coverage N90-29368

ANALYTICAL SERVICES AND MATERIALS, INC., HAMPTON, VA.
An enhanced integrated aerodynamic load/dynamic optimization procedure for helicopter rotor blades
[NASA-CR-4326] N90-29383

APTEK, INC., COLORADO SPRINGS, CO.
An interactive optimization based, computer graphics software package. Phase 2: Users manual
[AD-A223854] N90-29954

ARGONNE NATIONAL LAB., IL.
Ion-beam-assisted deposition of silver films on zirconia ceramics for improved tribological behavior
[DE90-009706] N90-29516
Adhesion of silver films to ion-bombarded zirconia
[DE90-010088] N90-29517
Ion-beam mixing of Fe/B layers for tribological applications
[DE90-010091] N90-29518
Practical superconductor development for electrical power applications
[DE90-014836] N90-30109

ARIZONA STATE UNIV., TEMPE.
Modeling and reconstruction algorithms for detection, location, and identification of subsurface anomalies
[AD-A224358] N90-29539
Basic properties and limits of integrated arrays of dissipative circuit and logic elements
[AD-A224533] N90-29567
Theory of electronic states and formations energies of defect complexes, interstitial defects, and crystal growth in semiconductors
[AD-A224069] N90-30093

ARIZONA UNIV., TUCSON.
Optical emissions from bombarding atmospheric gases with heavy ions
[AD-A223544] N90-30040
The Tempel 2 dust trail
[AD-A224395] N90-30153

ARMY AEROMEDICAL RESEARCH LAB., FORT RUCKER, AL.
Visual processing: Implications for helmet mounted displays
[AD-A223488] N90-29916

ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, PICATINNY ARSENAL, NJ.
Tip-position control of a flexible beam: Modeling approaches and experimental verification
[AD-A224249] N90-29643
Computer-aided engineering environment for controlled mechanical systems
[AD-A223551] N90-29942

ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, WATERVLIET, NY.
Effects of low Chromium(3) concentration in electrodeposition of low contraction chromium
[AD-A223338] N90-29477

ARMY BELVOIR RESEARCH AND DEVELOPMENT CENTER, FORT BELVOIR, VA.
Compatibility of elastomeric seal compounds with MIL-H-6083 and MIL-H-46170 hydraulic fluid
[AD-A224248] N90-29504

ARMY COMBAT SYSTEMS TEST ACTIVITY (PROVISIONAL), ABERDEEN PROVING GROUND, MD.
Techniques for developing a system safety risk assessment model
[AD-A223477] N90-29654

ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.
AutoPAVER: A software package for automated pavement evaluation
[AD-A224176] N90-29531

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Computer-Aided Structural Engineering (CASE) project: Investigation and design of U-frame structures using program CUFRBC. Volume A: Program criteria and documentation
[AD-A224387] N90-29934

ARMY LAB. COMMAND, WATERTOWN, MA.
The MTL Torsional Split-Hopkinson bar
[AD-A223278] N90-29663

ARMY TEST AND EVALUATION COMMAND, ABERDEEN PROVING GROUND, MD.
Radar receiver procedures
[AD-A224399] N90-29541
Airborne target detection, acquisition, and tracking devices
[AD-A223852] N90-29555

ARMY WAR COLL., CARLISLE BARRACKS, PA.
Total quality management: A recipe for success
[AD-A223287] N90-30122

ARNOLD ENGINEERING DEVELOPMENT CENTER, ARNOLD AIR FORCE STATION, TN.
Calibration of the PARC program for propulsion-type flows
[AD-A224253] N90-29395

ATOMIC ENERGY OF CANADA LTD., CHALK RIVER (ONTARIO).
Non-destructive evaluation of infiltration-toughened ceramics
[DE90-629716] N90-29501

ATOMIC ENERGY OF CANADA LTD., PINAWA (MANITOBA).
The nuclear battery
[DE90-630400] N90-29559

AUSTRALIAN NATIONAL UNIV., CANBERRA.
Regional phase propagation in three dimensionally heterogeneous media
[AD-A223279] N90-29731

B

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.
Supersonic/hypersonic aerodynamics and heat transfer for projectile design using viscous-inviscid interaction
[AD-A224354] N90-29303
Application of a rechargeable, small caliber railgun power supply
[AD-A224207] N90-29418
Direct numerical simulation of turbulent couette flow
[AD-A224287] N90-29589

BARCELONA UNIV. (SPAIN).
Proceedings of a discussion meeting on Thermodynamics of Alloys
[AD-A224336] N90-29476

BBN SYSTEMS AND TECHNOLOGIES CORP., CANOGA PARK, CA.
Audibility and annoyance of en route noise of unducted fan engines
[AD-A223687] N90-30035

Assessment System for Aircraft Noise (ASAN): Development of alpha-test prototype system software
[AD-A223770] N90-30036
BERTIN ET CIE., PLAISIR (FRANCE).
Preliminary hazard analysis in design application to EVA space suit
[ETN-90-97585] N90-29918
BOEING AEROSPACE CO., SEATTLE, WA.
Nonlinear modeling of joint dominated structures
[NASA-CR-4324] N90-29423
Guidance algorithms for a free-flying space robot N90-29798
BOLT, BERANEK, AND NEWMAN, INC., CAMBRIDGE, MA.
Telerobotic workstation design aid N90-29805
BOSTON COLL., CHESTNUT HILL, MA.
Database development for the DMSP experiments
[AD-A224346] N90-30129
BOSTON UNIV., MA.
A potential-vorticity decomposition for the boundary integral equation analysis of viscous flows N90-29301
Analysis of dynamic transient response and postflutter behavior of super-maneuvering airplane
[AD-A224126] N90-29386
Percolation and low density materials: Theory and applications
[AD-A224237] N90-29438
BRIGHAM YOUNG UNIV., PROVO, UT.
Novel macrocyclic carriers for proton-coupled liquid membrane transport
[DE90-015529] N90-29453
Supercritical fluid chromatography/supersonic jet spectroscopy
[DE90-015220] N90-29465
BROOKHAVEN NATIONAL LAB., UPTON, NY.
Recent progress in electronic structure calculations for defects in metals
[DE90-016323] N90-29494
Counter-current flow limitation in thin rectangular channels
[DE90-015124] N90-29599
Light scattering from surface and sub-surface defects
[DE90-016311] N90-30058
BUCHAREST UNIV. (ROMANIA).
Transformation group methods in plasma physics
[DE90-628755] N90-30074
BUREAU OF MINES, PITTSBURGH, PA.
Distributed communications and control network for robotic mining N90-29901

C

CALIFORNIA INST. OF TECH., PASADENA.
Dynamic consolidation of super hard materials
[AD-A224460] N90-29505
Structure in the near field of the transverse jet
[AD-A224502] N90-29591
An investigation of the inviscid spatial instability of compressible mixing layers
[AD-A223776] N90-29596
Research in nonlinear water waves
[AD-A224065] N90-29759
CALIFORNIA UNIV., BERKELEY.
Solid particle erosion in turbulent flows past tube banks
[DE90-015711] N90-29598
Systems reliability and inference: Summary of accomplishments 1988-1990
[AD-A224433] N90-29653
Norms and perception of events
[AD-A224236] N90-29774
The 3D model control of image processing N90-29800
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29828
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108
A search for low energy cosmic ray antiprotons N90-30161
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Powder processing of aluminides
[DE90-015314] N90-29447
Microstructure of alpha-Al base matrix/SiC particulate composites
[DE90-014894] N90-29449
Cyclic voltammetry at a rotating disk, electroreduction of nitrate in acidic nickel solutions, and frequency-response analysis of porous electrodes
[DE90-015317] N90-29466
Scanning tunneling microscopy studies of chemisorbed layers on metal surfaces
[DE90-015623] N90-29486
Electrochemical evaluation of new fluorosulfonic and fluorophosphonic acids as fuel cell electrolytes
[DE90-016626] N90-29699
Transmission electron microscopy study of ICB Al on Ge and Si(001) substrates
[DE90-015299] N90-30103
High resolution transmission electron microscopy of aluminophosphates
[DE90-015632] N90-30105
Subpicosecond Raman study of hot electrons and hot phonons in GaAs
[DE90-015634] N90-30106
Study of hot carrier relaxation in quantum wells by subpicosecond Raman scattering
[DE90-015635] N90-30107
High resolution transmission electron microscopy of partial states of oxygen order in YBa2Cu3O(z)
[DE90-015637] N90-30108
Fast pulsars, strange stars: An opportunity in radio astronomy
[DE90-015630] N90-30155
CALIFORNIA UNIV., DAVIS.
Particle dispersion in a turbulent shear flow
[AD-A224327] N90-29590
CALIFORNIA UNIV., IRVINE.
Trend analysis of total ozone data N90-29703
Time optimal movement of cooperating robots N90-29815
Anomalous decay of Langmuir turbulence. High power, high frequency radiation from beam-plasma interactions
[AD-A224282] N90-30065
CALIFORNIA UNIV., LOS ANGELES.
An additive turbulent decomposition of the Navier-Stokes equations implemented on highly parallel computer systems
[AD-A223678] N90-29595
Robust design of LQG controllers N90-29639
An observational study of the circulation in the Southern Hemisphere stratosphere N90-29715
Parallel architectures and algorithms for image understanding
[AD-A223479] N90-29940
Textual regularities applicable to full text searching: The case of family history literature N90-30125
CALIFORNIA UNIV., SAN DIEGO.
Some aspects of the structure and evolution of oceanic spreading centers N90-29757
CALIFORNIA UNIV., SAN DIEGO, LA JOLLA.
Kalman filter formulations for transfer alignment of strapdown inertial units N90-29342
Observability of relative navigation using range-only measurements N90-29360
Discrete-time adaptive control of robot manipulators N90-29834
Transport of nonneutral plasmas
[AD-A223457] N90-30077
CALIFORNIA UNIV., SANTA BARBARA.
High performance brittle matrices and brittle matrix composites, book 1
[AD-A223273] N90-29440
High performance brittle matrices and brittle matrix composites, book 2
[AD-A223274] N90-29441
Redundancy of space manipulator on free-flying vehicle and its nonholonomic path planning N90-29797
Controlling multiple manipulators using RIPS N90-29814
Vacuum mechatronics N90-29854
Inverse dynamics of a 3 degree of freedom spatial flexible manipulator N90-29878
CALSPAN CORP., ARNOLD AFS, TN.
Cavity aeroacoustics
[AD-A223853] N90-29307
CALSPAN CORP., BUFFALO, NY.
Thermographic phosphor technique N90-29324
CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
Inertial navigation system simulator program: Top-level design
[AD-A223762] N90-29379
Reflections on the relationship between artificial intelligence and operations research N90-29816
How to push a block along a wall N90-29848
Precedence relationship representations of mechanical assembly sequences N90-29866
Language and system support for concurrent programming
[AD-A223760] N90-29949
Durra: A task-level description language user's manual
[AD-A223761] N90-29950
Survey of formal specification techniques for reactive systems
[AD-A223741] N90-30005
CASE WESTERN RESERVE UNIV., CLEVELAND, OH.
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
Rotordynamic properties of high pressure seals: An experimental approach N90-29640
Electrochemical characteristics of acid electrolytes for fuel cells
[PB90-244385] N90-29693
CENTRAL INST. OF PHYSICS, BUCHAREST (ROMANIA).
On equations of motion on complex Grassman manifold
[DE90-628369] N90-29999
Gaussons and states with gaussian Wigner functions are quasi-free states
[DE90-628370] N90-30121
CENTRE D'ETUDES ET DE RECHERCHES, TOULOUSE (FRANCE).
Transition of the boundary layer
[DERAT-RSF-50/5018-37] N90-29600
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, TOULOUSE (FRANCE).
The indexed time table approach for planning and acting N90-29907
CENTRO BRASILEIRO DE PESQUISAS FISICAS, RIO DE JANEIRO.
Higher order equations of motion
[DE90-627522] N90-30038
CHEMICAL RESEARCH AND DEVELOPMENT CENTER, ABERDEEN PROVING GROUND, MD.
Estimation of liquid heat capacities. 1: Review and evaluation of Missenard method
[AD-A224161] N90-29454
Real-time concentration monitoring of large aerodynamic diameter fiber aerosols using the geometric optic inversion technique
[AD-A224167] N90-30048
CHICAGO UNIV., IL.
On discrete control of nonlinear systems with applications to robotics N90-29893
Experimental studies leading to energy storage. Spectroscopy and dynamics of polyatomic hydrogen in liquid, solid and gaseous hydrogen plasmas
[AD-A224343] N90-30066
CINCINNATI UNIV., OH.
Electrochemistry of metal surfaces
[AD-A224551] N90-29458
CIVIL AVIATION AUTHORITY, LONDON (ENGLAND).
UK airmisses involving commercial air transport: May - August 1989
[ISSN-0951-6301] N90-29335
Aircraft evacuations: The effect of passenger motivation and cabin configuration adjacent to the exit
[CAA-PAPER-89019] N90-29336
CLARKSON UNIV., POTSDAM, NY.
Influence of convection on microstructure
[NASA-CR-186506] N90-29470
COLORADO STATE UNIV., FORT COLLINS.
Grassland/atmosphere response to changing climate: Coupling regional and local scales
[DE90-015814] N90-29710
COLORADO UNIV., BOULDER.
Dynamic separation: Search for the cause of dynamic stall and search for its control
[AD-A223412] N90-29305
Chemical stabilization of laser dyes
[AD-A224219] N90-29627
Atmospheric methane data for the period 1983-1985 from the NOAA/GMCC global cooperative flask sampling network
[PB90-208588] N90-29701
Optical signal computing
[AD-A223624] N90-30051
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION (U.S. SENATE).
Global Climate Change: Seeking a Global Consensus
[S-HRG-101-842] N90-29704
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY (U.S. HOUSE).
NASA authorization, 1991, volume 2
[GPO-32-196] N90-30138
CORNELL UNIV., ITHACA, NY.
Programming your way out of the past: ISIS and the META Project
[NASA-CR-186275] N90-29922
Parallel and sparse methods for large-scale numerical optimization
[DE90-015655] N90-29959
Supporting large scale applications on networks of workstations
[NASA-CR-186348] N90-29975
Low cost management of replicated data in fault-tolerant distributed systems
[NASA-CR-186370] N90-29976

Reliable communication in the presence of failures
[NASA-CR-183046] N90-29977

COUNCIL ON ENVIRONMENTAL QUALITY, WASHINGTON, DC.
Environmental quality, 1970 - 1990
[PB90-214610] N90-29705

CRANFIELD INST. OF TECH., BEDFORD (ENGLAND).
Aircraft evacuations: The effect of passenger motivation and cabin configuration adjacent to the exit
[CAA-PAPER-89019] N90-29336
Assessment and improvement of aeroengine disc structural integrity N90-29392
An Ada-based marine radar simulator for collision avoidance training
[ETN-90-97611] N90-29970

CRYSTALLUME, MENLO PARK, CA.
Polycrystalline diamond Junction Field Effect Transistors (JFETS)
[AD-A223784] N90-29576

D

DANISH METEOROLOGICAL INST., COPENHAGEN.
Brorfelde Geomagnetic Observatory: Magnetic results, 1987
[ISBN-87-7478-297-5] N90-29756

DAVID TAYLOR RESEARCH CENTER, BETHESDA, MD.
Synthesis and property evaluation of Y-Ba2-Cu3-O(6+x) superconductors
[AD-A223494] N90-30098

DAYTON UNIV., OH.
Aircraft battle damage repair of transparencies
[AD-A224168] N90-29387
Structural testing and analytical research of turbine components
[AD-A223516] N90-29396
Terrain visual cue analysis for simulating low-level flight: A multidimensional scaling approach
[AD-A223564] N90-29407
Effect of environment upon mechanical behavior of structural ceramics for application in the DOE ceramic technology for advanced heat engines project
[DE90-014770] N90-29500
A 94 GHz transmissometer
[AD-A223309] N90-29618
Evaluation of plane-of-light noninterference stress measurement systems for measuring bladed disk vibrations
[AD-A223487] N90-29667

DEFENCE RESEARCH ESTABLISHMENT, OTTAWA (ONTARIO).
An integrated system for land navigation N90-29377

DELAWARE UNIV., NEWARK.
Two terminal CuInSe2 based cascade cells
[DE90-000383] N90-29697

DENVER UNIV., CO.
Measurements of the high altitude infrared characteristics of the atmosphere
[AD-A224401] N90-29728

DEPARTMENT OF ENERGY, NEW YORK, NY.
The Surface Air Sampling Program
[DE90-014873] N90-29711

DEPARTMENT OF ENERGY, WASHINGTON, DC.
Pulsed field sample neutralization
[DE90-015131] N90-29452
Leak detection aid
[DE90-014678] N90-29616
The dc arc weld starter
[DE90-014679] N90-29641
Quick-connect coupler for remote manipulation
[DE90-015352] N90-29648
Nondestructive material characterization
[DE90-015176] N90-29652
Digital color representation
[DE90-014580] N90-29924
FEDIX: An on-line information service for universities and other research organizations: User's guide
[DE90-014835] N90-30137

DEPARTMENT OF THE NAVY, WASHINGTON, DC.
Symmetrical layered thin film edge field-emitter-array and method for its production
[AD-D014594] N90-29569
Laser beam stop
[AD-D014595] N90-29629
An x ray source for lithography
[AD-D014596] N90-29630

DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK (GERMANY, F.R.).
Procedure for calibrating fly-by-wire control chains of the flying testbed ATTAS
[DLR-MITT-90-02] N90-29401
On the technology for preparation of a HeNe discharge tube for use in a laser gyro
[DLR-MITT-90-01] N90-29624

DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE (GERMANY, F.R.).
Exogenous and endogenous control of activity behavior and the fitness of fish
[DLR-FB-90-14] N90-29766

DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, GOETTINGEN (GERMANY, F.R.).
Electron beam for velocity determination N90-29319
Applications of LIF to high speed flows N90-29320
A numerical study of the response of the laminar unsteady separated flow about a circular cylinder to changes of boundary conditions
[DLR-FB-90-10] N90-29613

DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN (GERMANY, F.R.).
Active vibration damping of flexible structures
[DLR-FB-90-03] N90-29676
A documentation of icing-relevant cloud physical parameters on vertical soundings of stratiform clouds
[DLR-MITT-90-07] N90-29753
The skin temperature of mountain slopes and the determination of the sensible heat flux
[DLR-FB-90-07] N90-29754
Test and training simulator for ground-based teleoperated in-orbit servicing N90-29843
Estimation and representation of multidimensional mappings
[DLR-MITT-90-06] N90-29967

DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT, STUTTGART (GERMANY, F.R.).
Some studies related to a new Hexagonal Compound Parabolic Concentrator (HCPC) as a secondary in tandem with a solar tower
[DLR-FB-90-12] N90-29700

DIESEL COMPUTING SYSTEMS, INC., WOODLAND HILLS, CA.
Integration of GPS/INS with partitioned filters N90-29347

DREXEL UNIV., PHILADELPHIA, PA.
Coordination in a hierarchical multi-actuator controller N90-29900

DURHAM UNIV. (ENGLAND).
Report on the International Workshop on Progress Towards Molecular Scale Electronics
[AD-A223758] N90-29575

DYNAMIC ENGINEERING, INC., NEWPORT NEWS, VA.
Suspension systems for ground testing large space structures
[NASA-CR-4325] N90-29424

E

ECOLE NATIONALE D'INGENIEURS DE CONSTRUCTIONS AERONAUTIQUES, TOULOUSE (FRANCE).
Thermal transfers in unsteady compressible inviscid flow
[ETN-90-97557] N90-29311

EDINBURGH UNIV. (SCOTLAND).
A design strategy for autonomous systems N90-29818

EG AND G MOUND APPLIED TECHNOLOGIES, MIAMISBURG, OH.
Development and evaluation of hermetic laser diode ignited pyrotechnic components
[DE90-015745] N90-29529
Analysis of pyrotechnic devices by laser-illuminated high speed photography
[DE90-015741] N90-29530
An effective low-profile thermite torch
[DE90-015746] N90-29534
Finite difference modeling of laser diode ignited components
[DE90-015652] N90-29635

ELECTRONICS RESEARCH LAB., ADELAIDE (AUSTRALIA).
Control of a Cossor CSP1250 ionospheric simulator in an automated HF test bed
[AD-A223446] N90-29549
High range resolution radar cross-section profiles: A preliminary analysis
[AD-A223448] N90-29550

ELORET CORP., PALO ALTO, CA.
Theoretical investigation of non-equilibrium chemistry and optical radiation in hypersonic flow fields
[NASA-CR-186335] N90-29300

EMMANUEL COLL., BOSTON, MA.
Ionospheric irregularities: Source, structure, plasma processes and effects on sensor systems
[AD-A223908] N90-29723

ENVIRONMENTAL PROTECTION AGENCY, ROCKVILLE, MD.
Success of EPA's stratospheric ozone engineering research
[PB90-246265] N90-29706

ENVIRONMENTAL RESEARCH INST. OF MICHIGAN, ANN ARBOR.
Electro-optics engineering support for the integrated launch and recovery television surveillance system
[AD-A223450] N90-29406

EUROPEAN SPACE AGENCY, PARIS (FRANCE).
An introductory guide preparing to use the ESTEC environmental test facilities
[ESA-TM-05] N90-29419
The Ulysses data book: A summary of the technical elements of the Ulysses spacecraft and its scientific payload
[ESA-BR-65] N90-29427
ECS: Sixth year in orbit
[ESA-BR-70] N90-29428
Calculation of flow fields by the solution of the Euler equations using an extended finite volume discretization scheme
[ESA-TT-1204] N90-29605
The signals of an ice warning device in dependence on total water content and normalized icing degree
[ESA-TT-1207] N90-29692
Handbook of data compression algorithms
[ESA-TM-06] N90-29969
ESA's report to the 28th COSPAR meeting
[ESA-SP-1124] N90-30141
Activities report of the Space Science Department
[ESA-SP-1126] N90-30142
IUE-ULDA access guide no. 2. International Ultraviolet Explorer-Uniform Low Dispersion Archive: Comets
[ESA-SP-1134] N90-30157
Some personal reminiscences. The ESRO-ESA space science story: Twenty-five years of European cooperation
[ESA-BR-66] N90-30168
Activities report of the European Space Agency
[ISSN-0258-025X] N90-30169

EUROPEAN SPACE AGENCY. EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTER, ESTEC, NOORDWIJK (NETHERLANDS).
Concept synthesis of an equipment manipulation and transportation system EMATS N90-29844
ESTEC software catalogue
[ESA-SP-1133] N90-29968

F

FEDERAL AVIATION ADMINISTRATION, ATLANTIC CITY, NJ.
Communications Interface Driver (CID) software principles of operation
[DOT/FAA/CT-TN89/46] N90-29937

FEDERAL AVIATION ADMINISTRATION, WASHINGTON, DC.
FAA Rotorcraft Research, Engineering, and Development Bibliography 1962-1989
[AD-A224256] N90-29299
Reliability and performance of friction measuring tires and friction equipment correlation
[AD-A223694] N90-29408

FERMI NATIONAL ACCELERATOR LAB., BATAVIA, IL.
Microwave background distortions from domain walls
[NASA-CR-187272] N90-29556
Characteristic microwave background distortions from collapsing domain wall bubbles
[NASA-CR-187270] N90-29557
Relic gravitational waves and extended inflation
[NASA-CR-186469] N90-29740
Effective actions for bosonic topological defects
[NASA-CR-187271] N90-30041

FLORIDA STATE UNIV., TALLAHASSEE.
Problems in probability, statistics, and reliability
[AD-A224152] N90-30016

FLORIDA UNIV., GAINESVILLE.
High altitude balloon flight test of the GRAD experiment
[AD-A224398] N90-29388
Telepresence system development for application to the control of remote robotic systems N90-29799

FMC CORP., MINNEAPOLIS, MN.
Kinematics and control algorithm development and simulation for a redundant two-arm robotic manipulator system N90-29877

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, ROME (ITALY).
Factors affecting practical application of food irradiation
[DE90-631277] N90-29914

FRANKLIN AND MARSHALL COLL., LANCASTER, PA.
Response to reflected-force feedback to fingers in teleoperations N90-29837
FRAUNHOFER INST. FUER KURZZEITDYNAMIK, FREIBURG IM BREISGAU (GERMANY, F.R.).
Electrical ignition of HAN-based liquid propellants
[AD-A223272] N90-29528
FREIE UNIV., BERLIN (GERMANY, F.R.).
An electron spin resonance study of adsorbed gases in ultrahigh vacuum
[ETN-90-97323] N90-29469

G

GEC AVIONICS LTD., ROCHESTER (ENGLAND).
The potential for digital databases in flight planning and flight aiding for combat aircraft N90-29371
A low cost inertial/GPS integrated approach to land navigation N90-29374
GEC HIRST RESEARCH CENTRE, WEMBLEY (ENGLAND).
Integrated technology in MCT/GaAs and MCT/Si for medium and long wavelength infrared
[AD-A223557] N90-30100
GENERAL MOTORS TECHNICAL CENTER, WARREN, MI.
Satellite navigation systems for land vehicles N90-29376
GEOLOGICAL SURVEY, RESTON, VA.
Satellite image atlas of glaciers of the world: Irian Jaya, Indonesia, and New Zealand
[PB90-230095] N90-29691
GEORGE MASON UNIV., FAIRFAX, VA.
Analysis and evaluation of technical data on the photochronic and non-linear optical properties of materials
[AD-A223855] N90-30053
A survey of object-oriented database technology
[AD-A224490] N90-30130
GEORGIA INST. OF TECH., ATLANTA.
The Second ARO Workshop on Rotorcraft Interactional Aerodynamics
[AD-A223310] N90-29304
Numerical simulation supersonic free shear layers
[AD-A223771] N90-29306
Precursor structure-fiber property relationships in polyacrylonitrile-based carbon fibers
[AD-A224246] N90-29503
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
[AD-A224239] N90-29536
Modeling, design, and control of flexible manipulator arms: Status and trends N90-29782
Technology and task parameters relating to the effectiveness of the bracing strategy N90-29785
A discrete decentralized variable structure robotic controller N90-29835
GESAMTHOCHSCHULE, ESSEN (GERMANY, F.R.).
Calculation of turbulent air streams in driver cabs
[ETN-90-97320] N90-29310
GRENOBLE-1 UNIV. (FRANCE).
Optimization of tetrahedrical meshes for finite element calculation methods in fluids mechanics
[ETN-90-97560] N90-29603
GRUMMAN AEROSPACE CORP., BETHPAGE, NY.
Control strategies for a telerobot N90-29808

H

HAMPTON INST., VA.
Study of a 1-Hz hypocycloidal pinch (HCP) pump for production of ultraviolet lasers
[AD-A224091] N90-30064
HARVARD MEDICAL SCHOOL, BOSTON, MA.
Renal response to seven days of lower body positive pressure in the squirrel monkey
[NASA-CR-183355] N90-29761
HARVARD UNIV., CAMBRIDGE, MA.
Studies on crack mechanics
[AD-A223634] N90-29670
Interstellar magnetic fields: An observational perspective N90-30144
HELSINKI UNIV. (FINLAND).
AHTO project: Software technology for open distributed processing
[PB90-190943] N90-29923
Polarization correction of Luneburg lens with chiral medium
[PB90-189127] N90-30046
HITACHI LTD., TOKYO (JAPAN).
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124
HONEYWELL, INC., BLOOMINGTON, MN.
Optical symbolic processor for expert system execution
[AD-A224284] N90-29931
HONEYWELL, INC., MINNEAPOLIS, MN.
Determining robot actions for tasks requiring sensor interaction N90-29668
HOUSTON UNIV., CLEAR LAKE, TX.
A new momentum management controller for the space station
[NASA-CR-187265] N90-29425
HUGHES AIRCRAFT CO., FULLERTON, CA.
JTIDS relative navigation: Principles, architecture, and inertial mixing N90-29357
PLRS: A new spread spectrum position location reporting system N90-29358
Enhancing PLRS with user-to-user data capability N90-29359
HUMAN ENGINEERING LABS., ABERDEEN PROVING GROUND, MD.
A new diagnostics approach for repeated measures designs
[AD-A223500] N90-30020
Information processing and perceptual characteristics of display design: The role of emergent features and objects
[AD-A223683] N90-30133

I

IBM ITALIA, ROME.
Assembly of objects with not fully predefined shapes N90-29859
IDAHO NATIONAL ENGINEERING LAB., IDAHO FALLS.
Investigation of weld bead cooling rate during startup of gas metal arc welding
[AD-A223567] N90-29478
IIT RESEARCH INST., BARTLESVILLE, OK.
Production of jet fuels from coal-derived liquids. Volume 13: Evaluation of storage and thermal stability of jet fuels derived from coal liquids
[AD-A224576] N90-29527
ILLINOIS UNIV., CHAMPAIGN.
Physiological metrics of mental workload: A review of recent progress
[NASA-CR-187290] N90-29777
ILLINOIS UNIV., CHICAGO.
Trees, bialgebras and intrinsic numerical algorithms
[NASA-CR-187031] N90-29925
Control of helium accumulation
[DE90-015658] N90-30084
ILLINOIS UNIV., URBANA.
VLSI design for reliability
[AD-A224264] N90-29562
Knowledge base refinement as improving an incorrect and incomplete domain theory
[AD-A224441] N90-29935
An analysis of the distinction between deep and shallow expert systems
[AD-A224443] N90-29987
An algebraic hierarchical basis preconditioner
[DE90-015875] N90-30008
Overview of advanced fuel fusion
[DE90-015660] N90-30085
ILLINOIS UNIV., URBANA-CHAMPAIGN.
Adaptive control of an arc welding process
[AD-A223626] N90-29645
Unstable phenomena in mechanical systems
[AD-A223640] N90-30001
IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).
Unstructured mesh methods for CFD N90-29611
INSTITUT DE MECANIQUE DES FLUIDES DE LILLE (FRANCE).
Determination of density using simultaneous interferometry methods
[IMFL-90/04] N90-30061
INSTITUT FRANCO-ALLEMAND DE RECHERCHES, SAINT-LOUIS (FRANCE).
Interferometry N90-29315
Velocity interferometry N90-29316
INSTITUT NATIONAL DE RECHERCHE D'INFORMATIQUE ET D'AUTOMATIQUE, LE CHESNAY (FRANCE).
Trinocular stereovision using figural continuity, dealing with curved objects N90-29802
INSTITUT NATIONAL DE RECHERCHE D'INFORMATIQUE ET D'AUTOMATIQUE, RENNES (FRANCE).
Temporal logics meet telerobotics N90-29905
INSTITUTE FOR CIRCADIAN PHYSIOLOGY, BOSTON, MA.
Renal response to seven days of lower body positive pressure in the squirrel monkey
[NASA-CR-183355] N90-29761
Pharmacological resetting of the circadian sleep-wake cycle effects of triazolam on reentrainment of circadian rhythms in a diurnal primate
[AD-A224227] N90-29764
INSTITUTO DE PESQUISAS ENERGETICAS E NUCLEARES, SAO PAULO (BRAZIL).
A tandem system of ionization chambers for effective energy determination of unknown X-radiation fields
[DE90-630463] N90-29405
INSTITUTO DE PESQUISAS ESPACIAIS, SAO JOSE DOS CAMPOS (BRAZIL).
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA (AUSTRIA).
Factors affecting practical application of food irradiation
[DE90-631277] N90-29914
Human error classification and data collection
[DE90-631408] N90-29915
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS, TRIESTE (ITALY).
On hydrogen chemisorption on metals: The electron correlation effects
[DE90-627318] N90-29473
An instability theorem for a certain sixth order differential equation
[DE90-627150] N90-29990
Uniform dissipative solutions for some fourth order nonlinear differential equations
[DE90-627151] N90-29991
An existence theorem for periodic solutions and applications to some third order nonlinear differential equations
[DE90-627152] N90-29992
Oscillatory and nonoscillatory behaviour of solutions of an equation alternately of retarded and advanced type
[DE90-627159] N90-29993
Periodic solutions of certain fifth order differential equations
[DE90-627160] N90-29994
Some overdetermined systems of complex partial differential equations
[DE90-627162] N90-29995
The location of zeros using generalizations of Newton's method
[DE90-627168] N90-30023
An error estimate for Tremolieres method for the discretization of parabolic variational inequalities
[DE90-627169] N90-30024
A review of self generated B-field in ICF corona
[DE90-627479] N90-30063
New real space correlated-basis-functions approach for the electron correlations of the semiconductor inversion layer
[DE90-627315] N90-30090
Effect of retardation on the reflectance properties of the metallic Fibonacci quasi-superlattice
[DE90-627316] N90-30091
Surface photovoltage spectroscopy of real n-type GaAs(110) surfaces
[DE90-627325] N90-30092
On Dirac's conjecture for Hamiltonian systems with first and second class constraints
[DE90-627206] N90-30116
On a calculation of the ground-state energy in quantum mechanics
[DE90-627182] N90-30119
Introductory lectures on conformal field theory and strings
[DE90-627219] N90-30120
Information loss down a black hole
[DE90-627482] N90-30154
INTERSTATE ELECTRONICS CORP., ANAHEIM, CA.
Modular digital GPS receivers N90-29346
ISTITUTO ELABORAZIONE SEGNALI ED IMMAGINI, BARI (ITALY).
Information management in an integrated space telerobot N90-29846
ITALIAN SPACE AGENCY, ROME.
Information management in an integrated space telerobot N90-29846
IWG CORP., SAN DIEGO, CA.
A feasibility study for D-region equatorial ionosphere research using VLF radiowaves
[AD-A223685] N90-29738

J

JAI ASSOCIATES, INC., MOUNTAIN VIEW, CA.
Numerical simulations of blade-vortex interactions and lifting hovering rotor flows
[AD-A224238] N90-29302

JAPAN ATOMIC ENERGY RESEARCH INST., TOKYO.
Tokamak plasma shape identification with a Legendre-Fourier expansion of the vacuum poloidal flux function in the toroidal coordinates
[DE90-506031] N90-30068
JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.
Proceedings of the NASA Conference on Space Telerobotics, volume 3
[NASA-CR-186858] N90-29780
Use of 3D vision for fine robot motion N90-29804
Autonomous sensor-based dual-arm satellite grappling N90-29809
THREAD: A programming environment for interactive planning-level robotics applications N90-29810
Stability analysis of multiple-robot control systems N90-29811
Graphic overlays in high-precision teleoperation: Current and future work at JPL N90-29827
Proceedings of the NASA Conference on Space Telerobotics, volume 4
[NASA-CR-186859] N90-29830
Direct adaptive control of a PUMA 560 industrial robot N90-29832
Construction and demonstration of a 9-string 6 DOF force reflecting joystick for telerobotics N90-29836
The JAU-JPL anthropomorphic telerobot N90-29838
A procedure concept for local reflex control of grasping N90-29839
ROTEX-TRIIFEX: Proposal for a joint FRG-USA telerobotic flight experiment N90-29842
Force-reflective teleoperated system with shared and compliant control capabilities N90-29845
Global models: Robot sensing, control, and sensory-motor skills N90-29849
Efficient conjugate gradient algorithms for computation of the manipulator forward dynamics N90-29864
Proceedings of the NASA Conference on Space Telerobotics, volume 5
[NASA-CR-186860] N90-29874
Establishing viable task domains for telerobot demonstrations N90-29886
The JPL telerobotic Manipulator Control and Mechanization (MCM) subsystem N90-29892
A spatial operator algebra for manipulator modeling and control N90-29894
JOHNS HOPKINS UNIV., BALTIMORE, MD.
The overall response of composite materials undergoing large elastic deformations
[AD-A224509] N90-29439
Statistically designed study of the variables and parameters of carbon dioxide equations of state
[DE90-016196] N90-29467
IEEE Conference on Neural Information Processing Systems, Natural and Synthetic
[AD-A223611] N90-29552
JOINT PUBLICATIONS RESEARCH SERVICE, ARLINGTON, VA.
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-004] N90-29688
JPRS report: Science and technology. USSR: Earth sciences
[JPRS-UES-90-003] N90-29689
JPRS Report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-007] N90-29762
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-90-004] N90-29763

K

KANSAS UNIV., LAWRENCE.
Fighter agility metrics
[NASA-CR-187289] N90-29389
KENT STATE UNIV., OH.
Nucleus-nucleus collisions and the nuclear equation of state
[DE90-015427] N90-30037
KENT UNIV., CANTERBURY (ENGLAND).
Dust emission by Comet P/Halley 1982i N90-30159
KONGSBERG VAPENFABRIKK A/S (NORWAY).
Applications of differential GPS N90-29349

L

LABORATORIO DE COMPUTACAO CIENTIFICA, RIO DE JANEIRO (BRAZIL).
Dual and primal mixed Petrov-Galerkin finite element methods in heat transfer problems
[DE90-627190] N90-29592
LAMONT-DOHERTY GEOLOGICAL INST., PALISADES, NY.
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722
LAWRENCE LIVERMORE NATIONAL LAB., CA.
The influence of solidification rate on solute redistribution and second-phase formation in stainless steel alloys
[DE90-015189] N90-29482
Single-phase solidification during rapid resolidification of stainless steel alloys
[DE90-015190] N90-29483
Lapping: Polishing and shear mode grinding
[DE90-015188] N90-29533
High voltage picosecond pulse generation using avalanche diodes
[DE90-015194] N90-29577
Evaluation of dynamic range for LLNL streak cameras using high contrast pulses and pulse podiatry on the Nova laser system
[DE90-015203] N90-29620
Long-term flat-field behavior in LLNL streak cameras: Preliminary results
[DE90-015615] N90-29621
Model calculations for a 600 angstrom laser based on photopumping of Mo(sup 6+) by a spectral line of Mo(sup 11+)
[DE90-015202] N90-29634
Effects of increased CO2 on forest response
[DE90-015406] N90-29708
Tropospheric nitrogen: The influence of anthropogenic sources on distributions and deposition
[DE90-015408] N90-29709
Bispectral-based optimization algorithms for speckle imaging
[DE90-015610] N90-29957
Unstructured mesh relaxation
[DE90-015614] N90-29989
Prospects for nuclear astrophysics with intense radioactive ion beams
[DE90-015616] N90-30044
XMM space telescope: Development plan for the lightweight replicated x ray gratings
[DE90-015620] N90-30055
Comparison of electro-optic diagnostic systems
[DE90-015619] N90-30056
A distributed control and monitor system used in laser fusion research
[DE90-011483] N90-30078
Experimental observations of nonlinear effects in laser-plasma interactions
[DE90-015195] N90-30079
UCD-LLNL collaboration on basic plasma physics research in inertial confinement fusion
[DE90-015771] N90-30081
First principles calculation of oxygen ordering in YBa2Cu3O(7-y)
[DE90-015205] N90-30102
A comparative first principles study of phase stability in Ni-Ti and Ni-Al alloys around equiatomic composition
[DE90-016477] N90-30111
Monte Carlo simulation of complex spectra for opacity calculations
[DE90-015198] N90-30147
LITTON GUIDANCE AND CONTROL SYSTEMS, WOODLAND HILLS, CA.
Ring laser gyro principles and techniques N90-29352
Inertial grade fiber gyros N90-29353
Ring laser gyro marine inertial navigation systems N90-29355
Integrated navigation/flight control for future high performance aircraft N90-29362
Fault Detection and Isolation (FDI) techniques for guidance and control systems N90-29366
LOCKHEED ENGINEERING AND MANAGEMENT SERVICES CO., INC., HOUSTON, TX.
Flight telerobotic servicer control from the Orbiter N90-29882
LOCKHEED ENGINEERING AND SCIENCES CO., HAMPTON, VA.
Aircraft design for mission performance using nonlinear multiobjective optimization methods
[NASA-CR-4328] N90-29384
Design and evaluation of candidate pressure distribution and air data system tile penetration for the aeroassist flight experiment
[NASA-CR-4312] N90-29615
LOCKHEED ENGINEERING AND SCIENCES CO., HOUSTON, TX.
Dynamical modeling of serial manipulators with flexible links and joints using the method of kinematic influence N90-29783
Real-time cartesian force feedback control of a teleoperated robot N90-29857
Optimal payload rate limit algorithm for zero-G manipulators N90-29858
Recursive Newton-Euler formulation of manipulator dynamics N90-29862
Dexterous manipulator flight demonstration N90-29911
LOCKHEED MISSILES AND SPACE CO., PALO ALTO, CA.
Investigation of x ray variability in highly active cool stars
[NASA-CR-183853] N90-30143
LODESTAR RESEARCH CORP., BOULDER, CO.
Fundamental studies of fusion plasmas
[DE90-015732] N90-30080
LOS ALAMOS NATIONAL LAB., NM.
Observations of tornadoes and wall clouds with a portable FM-CW Doppler radar: 1989--1990 results
[DE90-013152] N90-29752
QTA (QUESTIONNAIRE-TASK-ANALYSIS): An electronic tool for job/task analysis
[DE90-008944] N90-29778
GSHELL: Multichannel analyzer/multichannel scaler emulation software for IBM-PC-compatible computers
[DE90-015396] N90-29956
A manual for microcomputer image analysis
[DE90-015629] N90-29958
The impact of IUE on studies of the nova outburst: 1986-1990
[DE90-014915] N90-30156
LOUGHBOROUGH UNIV. OF TECHNOLOGY (ENGLAND).
The cost of air service fragmentation
[TT-9010] N90-29334
The potential for an extra runway at Heathrow: A preliminary feasibility study
[TT-9007] N90-29403
Software design for high integrity systems
[ETN-90-97517] N90-29966
A new look at conjugate direction methods of optimization
[MATHS-REPT-A-125] N90-30010
A comparison of alternative families of transformations for variables constrained to lie on the interval (0,1)
[MATHS-REPT-A-126] N90-30011
LOUVAIN UNIV. (BELGIUM).
Design and control of a multi-fingered robot hand provided with tactile feedback N90-29789
Force/torque and tactile sensors for sensor-based manipulator control N90-29791
LOWELL UNIV., MA.
Investigation of structure and transport processes in the high latitude ionospheric plasma using ground based and airborne digisondes
[AD-A224397] N90-29727
High power oblique incidence HF ionospheric modification
[AD-A224402] N90-29729

M

MARTIN MARIETTA AEROSPACE, DENVER, CO.
Performance limitations of bilateral force reflection imposed by operator dynamic characteristics N90-29840
An efficient temporal logic for robotic task planning N90-29906
MARYLAND UNIV., COLLEGE PARK.
Nonlinear static and dynamic modeling of composite rotor blades including warping effects N90-29382
High average power CW FELS (Free Electron Laser) for application to plasma heating: Designs and experiments
[DE90-011085] N90-29633
The effects of gear reduction on robot dynamics N90-29861
MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Organic polyradical models for organic magnetic materials
[AD-A223691] N90-29435
Modification of polystyrene/polybutadiene block copolymer films by chemical reaction with bromine and effect on gas permeability
[AD-A223612] N90-29513
Research into traveling wave control in flexible structures
[AD-A224504] N90-29661
A vector diagram approach to shaping inputs for vibration reduction
[AD-A223724] N90-29671
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758
Interaction of electromagnetic fields with chondrocytes in gel culture
[AD-A223397] N90-29765

Use of graphics in decision aids for telerobotic control: (Parts 5-8 of an 8-part MIT progress report) N90-29629
The control of space manipulators subject to spacecraft attitude control saturation limits N90-29671
Preshaping command inputs to reduce telerobotic system oscillations N90-29880
Interset: A natural language interface for teleoperated robotic assembly of the EASE space structure N90-29885
Recognition by linear combination of models [AD-A224268] N90-29929
A comparison of hardware implementations for low-level vision algorithms [AD-A223699] N90-29945
Machine recognition as representation and search [AD-A223700] N90-29946
Fault tolerant design for multistage routing networks [AD-A224267] N90-29978
Innovative uses of parallel computers [AD-A223578] N90-29980
Direct estimation of structure and motion from multiple frames [AD-A223903] N90-29985
Automatic recognition of tractability in inference relations [AD-A223698] N90-30003
Lectures in plasma diagnostics [DE90-015825] N90-30086

MASSACHUSETTS INST. OF TECH., LEXINGTON.
Bistatic radar cross section of a perfectly conducting rhombus-shaped flat plate [AD-A223418] N90-29546
Jamming performance of frequency-hopped communication systems with nonuniform hopping distributions [AD-A223419] N90-29547
MUSE: A systolic array for adaptive nulling with 64 degrees of freedom, using Givens transformations and wafer scale integration [AD-A223612] N90-29953

MASSACHUSETTS UNIV., AMHERST.
State estimation for systems moving through random fields N90-29373
Theoretical investigations of Pi-conjugated polyradicals as models for organic magnetic materials [AD-A223411] N90-29481
Theoretical investigations and attempted synthesis of organic magnetic polymers and oligomers [AD-A223409] N90-29509
Progress toward synthesis of polymeric polyradicals [AD-A223414] N90-29510
Medium energy nuclear physics research [DE90-015852] N90-30042
Formation of hydrogen line and continuum emission in young stellar objects N90-30150
Carbon monoxide isotopes and clumping in giant molecular clouds N90-30151

MATERIALS RESEARCH LABS., ASCOT VALE (AUSTRALIA).
A review of manganin gauge technology for measurements in the gigapascal range [MRL-TR-90-5] N90-30026

MAX-PLANCK-INST. FUER STROEMUNGSFORSCHUNG, GOETTINGEN (GERMANY, F.R.).
Laser induced fluorescence imaging applications N90-29322

MCDONNELL AIRCRAFT CO., SAINT LOUIS, MO.
Application of multifunction inertial reference systems to fighter aircraft N90-29341
Survivable penetration N90-29363

MECHANICAL ENGINEERING LAB., TSUKUBA (JAPAN).
Robotic tele-existence N90-29796

METRAFLU, ECULLY (FRANCE).
Technique for the measurement of noise of the flow associated to the small wave numbers of the turbulence spectra [ETN-90-97558] N90-29601
Secondary flow in presence of wall jets: Incorporation of compression effects in a quasi-elliptic Navier-Stokes calculation code [ETN-90-97559] N90-29602

MICHIGAN UNIV., ANN ARBOR.
Tele-autonomous systems: New methods for projecting and coordinating intelligent action at a distance N90-29794
Learning in tele-autonomous systems using Soar N90-29819
Heavy Nucleus Collector (HNC) project for the NASA Long Duration Exposure Facility (LDEF) [NASA-CR-182094] N90-30045
Nonlinear optical studies of the optical and electronic properties of semiconductor heterostructures [AD-A223408] N90-30096

MIDWEST RESEARCH INST., GOLDEN, CO.
Comparison of wind tunnel airfoil performance data with wind turbine blade data [DE90-000343] N90-29308
Basic studies of 3-V high efficiency cell components [DE90-000360] N90-29696
Two terminal CuInSe2 based cascade cells [DE90-000363] N90-29697

MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY, TOKYO (JAPAN).
Multi-level manual and autonomous control superposition for intelligent telerobot N90-29888

MINNESOTA UNIV., DULUTH.
Evaluation of physiological and psychological impairment of human performance in cold stressed subjects [AD-A223635] N90-29769

MINNESOTA UNIV., MINNEAPOLIS.
Rheology of filler rubber: Silica-silicone [AD-A223600] N90-29511
Effect of particulate fillers on the rheology of polymer melts [AD-A223601] N90-29512
Ability and metacognitive determinants of skill acquisition and transfer [AD-A224569] N90-29776

MISSION RESEARCH CORP., ALBUQUERQUE, NM.
Beam and plasma physics research [AD-A224452] N90-30067

MISSION RESEARCH CORP., SANTA BARBARA, CA.
The effects on antenna-filtered scintillation parameters of non-zero antenna pointing angles [AD-A223840] N90-29554

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE.
Elliptic grid generation N90-29612
Diagnostic development and support of MHD test facilities [DE90-015403] N90-30083

MISSOURI UNIV., COLUMBIA.
Microscopic models for electromagnetic wave propagation in highly dispersive media [AD-A224382] N90-29540

MISSOURI UNIV., ROLLA.
Design of a structural and functional hierarchy for planning and control of telerobotic systems N90-29820

MITRE CORP., BEDFORD, MA.
Effects of parameter uncertainties on software development effort estimates [AD-A223304] N90-29938
Machine learning [AD-A223732] N90-29988

MITRE CORP., MCLEAN, VA.
Independent ground monitor coverage of Global Positioning System (GPS) satellites for use by civil aviation N90-29364
Analysis of the integrity of the Microwave Landing System (MLS) data functions N90-29365

MONTANA STATE UNIV., BOZEMAN.
Oxidation of NiAl(110) [DE90-015645] N90-29487

N

NAPLES UNIV. (ITALY).
Infrared thermography N90-29325
On the manipulability of dual cooperative robots N90-29813

NATIONAAL INST. VOOR KERNFYSICA EN HOGE ENERGIEFYSICA, AMSTERDAM (NETHERLANDS).
High frequency bundle protection [DIGEL-1990-1] N90-29582
Investigation of the application in the simulation program 'PSpice' of the Jiles-Atherton model for nonlinear magnetic materials in order to predict the degaussing of magnets [LINO-1990-1] N90-30029

NATIONAL AERONAUTICAL LAB., BANGALORE (INDIA).
Development of a software package for automatic data acquisition, analysis, and controls in an axial flow compressor test rig [PD-PR-8910] N90-29926

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CA.
Head-mounted spatial instruments II: Synthetic reality or impossible dream N90-29828

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
Data catalog series for space science and applications flight missions. Volume 5A: Descriptions of astronomy, astrophysics, and solar physics spacecraft and investigations. Volume 5B: Descriptions of data sets from astronomy, astrophysics, and solar physics spacecraft and investigations [NASA-TM-101908] N90-29413
Data catalog series for space science and applications flight flight missions. Volume 2B: Descriptions of data sets from geostationary and high-altitude scientific spacecraft and investigations [NASA-TM-101909] N90-29414
Data catalog series for space science and applications flight missions. Volume 1A: Descriptions of planetary and heliocentric spacecraft and investigations, second edition [NASA-TM-101910] N90-29415
Data catalog series for space science and applications flight missions. Volume 6: Master index volume [NASA-TM-101913] N90-29416
Results from Alouette 1, Explorer 20, Alouette 2, and Explorer 31 [NASA-TM-101822] N90-29690
The worldwide ionospheric data base [NASA-TM-101823] N90-29714
The flight telerobotic servicer: NASA's first operational space robot N90-29781
The flight telerobotic servicer project: A technical overview N90-29821
The flight telerobotic servicer Tinman concept: System design drivers and task analysis N90-29822
Research and development activities at the Goddard Space Flight Center for the flight telerobotic servicer project N90-29824
The Goddard Space Flight Center (GSFC) robotics technology testbed N90-29825
Test and validation for robot arm control dynamics simulation N90-29826
The telerobot workstation testbed for the shuttle aft flight deck: A project plan for integrating human factors into system design N90-29887
Data catalog series for space science and applications flight missions. Volume 4B: Descriptions of data sets from meteorological and terrestrial applications spacecraft and investigations [NASA-TM-101880] N90-30123
Data catalog series for space science and applications flight missions. Volume 3B: Descriptions of data sets from low- and medium-altitude scientific spacecraft and investigations [NASA-TM-89680] N90-30140
Data catalog series for space science and applications flight missions. Volume 1B: Descriptions of data sets from planetary and heliocentric spacecraft and investigations [NASA-TM-89695] N90-30148
Interplanetary medium data book, supplement 4, 1985-1988 [NASA-TM-101867] N90-30149
A guide to the National Space Science Data Center [NASA-TM-89637] N90-30167

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FL.
An advanced telerobotic system for shuttle payload changeout room processing applications N90-29795

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TX.
Uniform task level definitions for robotic system performance comparisons N90-29855
Telerobotic activities at Johnson Space Center N90-29875
Application of recursive manipulator dynamics to hybrid software/hardware simulation N90-29876
Integration of a sensor based multiple robot environment for space applications: The Johnson Space Center Teleoperator Branch Robotics Laboratory N90-29890
Flight experiments in telerobotics-Orbiter middeck concept N90-29895
Shuttle remote manipulator system mission preparation and operations N90-29909
A comparison of the Shuttle remote manipulator system and the Space Station Freedom mobile servicing center N90-29910
An intelligent, free-flying robot N90-29912

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.
Characterization of unnotched SCS-6/Ti-15-3 metal matrix composites at 650 C [NASA-TM-102699] N90-29450
System architectures for telerobotic research N90-29872

Comparison of joint space versus task force load distribution optimization for a multiarm manipulator system N90-29873
The development and evaluation of numerical algorithms for MIMD computers
[NASA-TM-101167] N90-29939
Formal design and verification of a reliable computing platform for real-time control. Phase 1: Results
[NASA-TM-102716] N90-29965
Using minimal spanning trees to compare the reliability of network topologies
[NASA-TM-4208] N90-30014
External information sources and aerospace R/D: The use and importance of technical reports by US Aerospace engineers and scientists
[NASA-TM-101232] N90-30132

NATIONAL AEROSPACE LAB., TOKYO (JAPAN).
Investigation of ATP blades, part 2. Validation of two-dimensional viscous flow simulation codes around thin airfoils
[NAL-TR-1046] N90-29326
Transonic 3-D Euler analysis of flows around fanjet engine and TPS (Turbine Powered Simulator). Comparison with wind tunnel experiment, evaluation of TPS testing method and 3-D flow
[NAL-TR-1045] N90-29327
A boundary-layer transition model for the Navier-Stokes computation for a natural-laminar-flow airfoil
[NAL-TR-1038T] N90-29328
Aerodynamic forces acting on a finite rectangular slender body
[NAL-TR-1035] N90-29329
Numerical simulation of hypersonic viscous flow for the design of H-2 orbiting plane (HOPE)
[NAL-TR-1028] N90-29330
A numerical calculation of hypersonic flow around blunt bodies using upwind difference scheme
[NAL-TR-1025] N90-29331
Some topics in computational transonic aerodynamics: Revision
[NAL-TR-1018T] N90-29332
Airline productivity relating on the fuel cost. (2): Fuel consumption values and fuel efficiency
[NAL-TM-604-2] N90-29333
Evaluation for DLC-Flap Monitoring System of the VSRA
[NAL-TM-607] N90-29391
A comparison of scramjet engine performances of various cycles
[NAL-TR-1042] N90-29397
Analysis of scramjet engine characteristics
[NAL-TR-1041] N90-29398
Short period control using angular acceleration feedback: Compensation for first lag servo
[NAL-TM-600] N90-29399
A digital controller for active aeroelastic controls
[NAL-TR-1014] N90-29402
Studies of surface heat transfer in an arc-heated wind tunnel
[NAL-TR-1048] N90-29410
Estimation of power spectral density of runway roughness
[NAL-TR-1037] N90-29411
The function of the Interactive Model Assembly Program (IMAP) for a flight simulator
[NAL-TR-1034] N90-29412
Theoretical specifications of the trajectory estimation for a space navigation system with the function of guidance and control
[NAL-TR-1032] N90-29420
Utilization of space station, part 3
[NAL-TM-597-PT-3] N90-29422
Combustion characteristics of oxygen/hydrogen high pressure preburners for staged combustion cycle rocket engine
[NAL-TR-1044] N90-29434
Surface effect for test piece on flexural test of carbon fiber reinforced plastic laminates
[NAL-TM-601] N90-29436
Evaluation of static and fatigue properties of thin sheets of 8090-T8 aluminum-lithium alloy and observation of its fracture surfaces
[NAL-TR-1039] N90-29499
Approximate equations for heat conduction in multi-layered cylindrical shells
[NAL-TR-1049] N90-29614
Characteristics of pushbroom scanning type radiometer utilizing linear sensors
[NAL-TR-1024] N90-29625
A method of determining a laser-velocimeter focal point and measuring its beam properties using a hot-wire anemometer
[NAL-TR-1043] N90-29626
Investigation of fluid dynamic performance of LE-7 liquid oxygen pump
[NAL-TR-1020] N90-29650
Lubrication characteristics of rolling bearings lubricated by self-lubricating composite retainers. Part 1: Selection of bearings for Earth sensors
[NAL-TR-1019] N90-29651
Friction, wear and electric characteristics of slip-ring brush materials for space applications. Part 1: Screening by pin-on-disk friction tests
[NAL-TR-1040] N90-29657
Fractographic analysis of fatigue failures of airframe equipment parts: Examples of a rod end housing and a rod end cap
[NAL-TR-1047] N90-29686
Noncontact measurement of rotating blade vibrations
[NAL-TR-1033] N90-29687
Assembler for a parallel computer
[NAL-TM-586] N90-29974
Parametric studies of acoustic duct attenuation ofperforated-plate-on-honeycomb absorber
[NAL-TM-603] N90-30030

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.
Geophysical turbulence research at NCAR
[AD-A223361] N90-29732

NATIONAL CENTER FOR EARTHQUAKE ENGINEERING RESEARCH, BUFFALO, NY.
Catalog of strong motion stations in Eastern North America
[PB90-251984] N90-29722

NATIONAL DEFENCE RESEARCH ESTABLISHMENT, STOCKHOLM (SWEDEN).
Activities of the Division of Microwave Technology
[FOA-C-30555-3.2] N90-29537

NATIONAL INST. FOR FUSION SCIENCE, NAGOYA (JAPAN).
Symmetry and island structure of the standard map
[DE90-508076] N90-30069
Stochastic properties of the plasma wave heating map
[DE90-508077] N90-30070
Three dimensional studies of helical equilibria and magnetic surface breaking due to the finite beta effect
[DE90-508078] N90-30071
A model of peaked density profile and inward pinch in tokamaks
[DE90-508079] N90-30072
Spatial structure of particle-orbit loss regions in l=2 helical systems
[DE90-508080] N90-30073

NATIONAL INST. OF STANDARDS AND TECHNOLOGY, GAITHERSBURG, MD.
Mechanical properties and fracture toughness of AAR-TC128 Grade B steel and a micro-alloyed, control-rolled steel, A 8XX grade B, from -80F to +73F
[PB90-207796] N90-29471
Concept for a reference model Architecture for Real-Time Intelligent Control Systems (ARTICS)
[PB90-220286] N90-29638
The flight telerobotic servicer: From functional architecture to computer architecture N90-29823
Requirements for implementing real-time control functional modules on a hierarchical parallel pipelined system N90-29891
Approach to telerobot computing architecture
[NASA-CR-186993] N90-29984
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
Working implementation agreements for open systems interconnection protocols
[PB90-197948] N90-30127

NATIONAL LAB. FOR HIGH ENERGY PHYSICS, TSUKUBA (JAPAN).
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, SILVER SPRING, MD.
Meteorological conditions over the North Atlantic Ocean during GCE/CASE/WATOX
[PB90-252032] N90-29747

NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).
Evaluation of a thermistor power measurement system for use on the NPL antenna extrapolation range
[NPL-DES-89] N90-29583
Analytic least squares
[NPL-DES-86] N90-29971

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO).
A fast 3-D object recognition algorithm for the vision system of a special-purpose dexterous manipulator N90-29803

NATIONAL SPACE DEVELOPMENT AGENCY, TOKYO (JAPAN).
A three axis attitude control of a satellite
[NASDA-TR-22] N90-29421

NAVAL AEROSPACE MEDICAL RESEARCH LAB., PENSACOLA, FL.
Vestibular responses and motion sickness during pitch, roll, and yaw sinusoidal whole-body oscillation
[AD-A223898] N90-29767

NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PA.
An analysis of GPS as the sole means navigation system in US Navy aircraft N90-29350
A low cost shadow moire device for the nondestructive evaluation of impact damage in composite laminates
[AD-A223451] N90-29442
Evaluation of ARALL-4: An aramid fiber reinforced aluminum
[AD-A223502] N90-29443

NAVAL COASTAL SYSTEMS CENTER, PANAMA CITY, FL.
Modeling towed cable system dynamics
[AD-A223610] N90-29644

NAVAL HEALTH RESEARCH CENTER, SAN DIEGO, CA.
Minimal sleep to maintain performance: Search for sleep quantum in sustained operations
[AD-A223815] N90-29770
Optimism and cardiovascular reactivity to psychological and cold pressor stress
[AD-A223818] N90-29771
Coping strategies and mood during cold weather training
[AD-A223915] N90-29773

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY, BAY SAINT LOUIS, MS.
A global approach to image texture analysis
[AD-A223532] N90-29941

NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CA.
Observability of relative navigation using range-only measurements N90-29360
Satellite Constellation Orbit Evaluation (SCORE) program
[AD-A223531] N90-29417
Specification for a standard electromagnetic propagation model
[AD-A223556] N90-29551
Radar clutter via ray methods
[AD-A223786] N90-29553
Pyrromethene-BF2 complexes as laser dyes
[AD-A223562] N90-29631

NAVAL POSTGRADUATE SCHOOL, MONTEREY, CA.
The roles of strain and reheating interval in continuous recrystallization during the thermomechanical processing by warm rolling of an Al-Mg alloy
[AD-A223673] N90-29479
The stress and temperature dependence of creep in an Al-2.0 wt percent Li alloy
[AD-A223676] N90-29480
An experimental investigation of strand burning metallized solid propellants
[AD-A224074] N90-29526
An experimental study of voice communication over a bandlimited channel using variable bit width delta modulation
[AD-A223445] N90-29548
Evaluation of a potential Wave Division Multiplexer (WDM) for use in the IRSTD
[AD-A223945] N90-29560
CAD models for inductive strips in homogeneous finline: The methodology
[AD-A224446] N90-29564
Further studies of turbulence structure resulting from interactions between embedded vortices and wall jets at high blowing ratios
[AD-A223296] N90-29593
Effects of 1 Hz imposed bulk flow unsteadiness on laminar/turbulent transition in a straight channel
[AD-A223396] N90-29594
Apparatus to determine the complex mass of a viscous fluid contained in a rigid porous solid from acoustic pressure measurements
[AD-A223709] N90-29619
Investigation of a heat driven thermoacoustic prime mover
[AD-A223928] N90-29694
Vehicle path-planning in three dimensions using optics analogs for optimizing visibility and energy cost N90-29853
Computer simulation and design of a three degree-of-freedom shoulder module N90-29902
Turbo pascal implementation of a distributed processing network of MS-DOS microcomputers connected in a master-slave configuration
[AD-A223925] N90-29928
Issues in expanding the software base management system supporting the Computer Aided Prototyping System (CAPS)
[AD-A224344] N90-29933

Graphic interface for attribute-based data language queries from a personal computer to the multi-lingual, multi-model, multi-backend database system over an Ethernet network
[AD-A223738] N90-29948
MacRootLocus: A CAD design tool for feedback control systems
[AD-A223772] N90-29951
Sensitivity of the error in multivariate statistical interpolation to parameter values
[AD-A224076] N90-30015
A reduced-order extended Kalman filter for moving images
[AD-A223742] N90-30028
Numerical pulse propagation studies using two classical ocean waveguide models
[AD-A224118] N90-30033
Establishment of a capability to measure optical transition radiation
[AD-A224094] N90-30047
Accessing network databases via SQL transactions in a multi-model database system
[AD-A223946] N90-30128

NAVAL RESEARCH LAB., WASHINGTON, DC.
Shear-resistant drag reduction polymers. Part 1: Molecular investigations of polymer drag reduction and the development of laboratory screening methods
[AD-A223353] N90-29508
High power microwaves for defense and accelerator applications
[AD-A223550] N90-29572
Numerical simulations of the structure of supersonic shear layers
[AD-A224164] N90-29587
Reynolds stress and the physics of turbulent momentum transport
[AD-A224172] N90-29588
Tests of initialization procedures with the NRL limited area numerical weather prediction model
[AD-A223549] N90-29750
A high-speed KDL-RAM file system for parallel computers
[AD-A223299] N90-29979
Soft x ray emission spectra from laser-irradiated high-Z targets
[AD-A223552] N90-30099

NAVAL UNDERWATER SYSTEMS CENTER, NEW LONDON, CT.
Spectral measurements of the wall shear stress and wall pressure in a turbulent boundary layer: Theory
[AD-A224070] N90-29586
Performance monitoring, fault detection, fault localization design guidance
[AD-A223619] N90-29655

NAVAL WEAPONS CENTER, CHINA LAKE, CA.
A planar rocket motor model for visualization of violent reaction due to fragment impact
[AD-A224273] N90-29431
Proceedings of the 14th Annual Electronics Manufacturing Seminar
[AD-A224276] N90-29563
Multisensor evaluation framework
[AD-A224271] N90-29613
Tutorial on using LISP object-oriented programming for blackboards: Solving the radar tracking problem
[AD-A224272] N90-29930
Optimal control law phenomena in certain adaptive second-order observation systems
[AD-A224274] N90-29986

NAVSTAR SYSTEMS DEVELOPMENT, MONUMENT, CO.
GPS integrity requirements for use by civil aviation N90-29339

NEBRASKA UNIV., LINCOLN.
Application of the complex variable solution to some problems in linear elastic materials with voids N90-29658

NETROLOGIC, INC., SAN DIEGO, CA.
Image compression
[AD-A224242] N90-29998

NEW MEXICO UNIV., ALBUQUERQUE.
Processing of nanocrystalline ceramics
[DE90-015700] N90-29520
Novel approaches to sensitivity enhancement of ring laser gyros
[AD-A224335] N90-29617

NEW YORK UNIV., NEW YORK.
Attention, imagery, and memory: A neuromagnetic investigation
[AD-A224560] N90-29775
Teleoperation experiments with a Utah/MIT hand and a VPL DataGlove N90-29883

NORTH CAROLINA STATE UNIV., RALEIGH.
The 3-D vision system integrated dexterous hand N90-29850

NORTH CAROLINA UNIV., CHAPEL HILL.
Sigma and pi interactions of the pyrrolic ligand sandwich-like lanthanide phthalocyanines determined from magnetic susceptibility and ligand-field theory
[AD-A223609] N90-29444
Tail and quantile estimation for strongly mixing stationary sequences
[AD-A223472] N90-30019
Trapezoidal stratified Monte Carlo integration
[AD-A223565] N90-30021
Propagation of chaos and the McKean-Vlasov equation in duals of nuclear spaces
[AD-A224431] N90-30039

NORTHEAST SEMICONDUCTOR, INC., ITHACA, NY.
Innovative techniques for the production of low cost 2D laser diode arrays
[AD-A223575] N90-29632
High throughput MBE materials for MODFET's
[AD-A223452] N90-30097

NORTHROP CORP., HAWTHORNE, CA.
Control and estimation for aerospace applications with system time delays N90-29367

NORTHROP CORP., NORWOOD, MA.
Integration of GPS and strapdown inertial subsystems into a single unit N90-29340

NORTHWEST RESEARCH ASSOCIATES, INC., BELLEVUE, WA.
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A224392] N90-29725
An assessment of the application of in situ ion-density data from DMSP to modeling of transionospheric scintillation
[AD-A222695] N90-29730

NORTHWESTERN UNIV., EVANSTON, IL.
Investigation of the dynamic buckling of liquid-filled tanks N90-29660
Investigation of YBa2Cu3O(7-sigma) by NMR and construction of an ultra low temperature cryostat N90-30088

NORWEGIAN DEFENCE RESEARCH ESTABLISHMENT, KJELLER.
Detection and analysis of wind fronts and current shear in digital SAR images
[FFI-89/7016] N90-29755

NOTRE DAME UNIV., IN.
The DELTA MONSTER: An RPV designed to investigate the aerodynamics of a delta wing platform
[NASA-CR-186226] N90-29381

NOTTINGHAM UNIV. (ENGLAND).
Numerical simulation of the lightning return stroke N90-29743

O

OAK RIDGE GASEOUS DIFFUSION PLANT, TN.
Automated CADAM data transfer: User's manual
[DE90-014871] N90-29963

OAK RIDGE NATIONAL LAB., TN.
The friction and wear of lubricated Si3N4/SiC(w) composites
[DE90-015790] N90-29448
Investigation of the effects of microalloy constituents, surface treatment and oxidation conditions on the development and breakdown of protective oxide scales
[DE90-015710] N90-29488
Alloy design of ordered intermetallics
[DE90-016031] N90-29490
Multiaxial fatigue criterion for 2-1/4 Cr-1 Mo steel for use in high-temperature structural design
[DE90-016039] N90-29491
The use of automated ball indentation testing to measure flow properties and estimate fracture toughness in metallic materials
[DE90-015797] N90-29493
Effect of environment upon mechanical behavior of structural ceramics for application in the DOE ceramic technology for advanced heat engines project
[DE90-014770] N90-29500
Wear of advanced ceramics: An overview
[DE90-012166] N90-29519
A cost-effective realization of environmental temperature control
[DE90-011651] N90-29532
Performance test plan for variable-speed ac superconducting motor
[DE90-016208] N90-29579
Solid particle erosion in turbulent flows past tube banks
[DE90-015711] N90-29598
Scale effects in steady-state friction
[DE90-012943] N90-29647
Robots, systems, and flexible automation
[DE90-015802] N90-29649
Neural nets and eddy-current testing
[DE90-016044] N90-29656
An investigation of crack-tip stress field criteria for predicting cleavage-crack initiation
[DE90-015597] N90-29672
Accurate calculations of neutron kerma and damage from ENDF/B-VI evaluations for silicon, chromium, iron and nickel, and comparison with ENDF/B-V results
[DE90-016020] N90-29674
SamTrack: A sample tracking system for environmental monitoring
[DE90-016026] N90-29712
Traction-drive force transmission for telerobotic joints N90-29790
The laboratory telerobotic manipulator program N90-29869
Developing tools for performance visualization of parallel algorithms
[DE90-015801] N90-29960
Superconductivity and information exchange
[DE90-015767] N90-30110
Knowledge-based expert system configurator
[DE90-011711] N90-30135

ODYSSEY RESEARCH ASSOCIATES, INC., ITHACA, NY.
Formal verification of mathematical software, volume 2
[AD-A223633] N90-29943

OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES, PARIS (FRANCE).
Feasibility of the temperature measurements in hypersonic flow by multibeam coherent Raman anti-Stokes scattering
[ONERA-RF-56/7131-PY] N90-29312
Theoretical study of the interaction between an oblique shock wave and a turbulent boundary layer from a heated wall
[ONERA-RSF-87/7078/AY-100-A] N90-29313
Laser velocimetry N90-29317
CARS spectroscopy and applications N90-29321
Fundamental studies on intermetallic compounds
[ONERA-RT-4/1855-M] N90-29497
Realization of equipment for manufacturing titanium alloy electrodes for first step melting
[ONERA-RT-15/3578-M] N90-29498
A method for modeling kinematic hardening and cyclic strain effects
[ONERA-RT-77/1765-RY-089-R] N90-29677
Parallelization of a method for solving three dimensional Navier-Stokes equations on a distributed memory multiprocessor
[ONERA-RTS-1/3717-CY] N90-29983

OHIO STATE UNIV., COLUMBUS.
Variational formulation and finite element implementation of Pagano's theory of laminated plates N90-29437
Proceedings of the 45th Ohio State University Symposium on Molecular Spectroscopy
[AD-A224349] N90-29457
Simulation and measurement of the heat exchange between the urban canopy and boundary layers N90-29702
Zonal winds between 25 and 120 km retrieved from solar occultation spectra N90-29718
Experiments in identification and control of flexible-link manipulators N90-29787
What kind of computation is intelligence. A framework for integrating different kinds of expertise N90-29817
A layered abduction model of perception: Integrating bottom-up and top-down processing in a multi-sense agent N90-29851
Generic task problem solvers in Soar N90-29904

OKLAHOMA STATE UNIV., STILLWATER.
The effect of software reusability on information theory based software metrics
[AD-A224472] N90-29936

OMEGA NAVIGATION SYSTEM CENTER, ALEXANDRIA, VA.
Omega navigation signal characteristics N90-29369

OSAKA CITY UNIV. (JAPAN).
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164

OSAKA UNIV., TOYONAKA (JAPAN).
Modeling and sensory feedback control for space manipulators N90-29807

OSNABRUECK UNIV. (GERMANY, F.R.).
Photoinduced and holographically reinforced light diffusion in electrooptic crystals
[ETN-90-97321] N90-30060

P

PACIFIC NORTHWEST LAB., RICHLAND, WA.
Swelling of neutron irradiated vanadium alloys
[DE90-015294] N90-29472

Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated invar-type alloys
[DE90-015293] N90-29484
Tensile behavior and swelling of ternary austenitic alloys irradiated in different neutron spectra
[DE90-015295] N90-29485
Isotopic tailoring and other techniques used to study helium effects in austenitic alloys
[DE90-016344] N90-29495
The effect of helium on microstructural evolution in austenitic steels as determined by spectral tailoring experiments
[DE90-016360] N90-29496
Planar waveguide spectrometer
[DE90-016308] N90-30057
Advanced materials and electrochemical processes in high-temperature solid electrolytes
[DE90-015552] N90-30104
The technology transfer process: Background for the national energy strategy
[DE90-015301] N90-30139

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
Prediction and control of processing-induced residual stresses in composites. Part 2: AS4/PEEK composite
[AD-A223696] N90-29445
Surface chemistry and structural effects in the stress corrosion of glass and ceramic materials
[AD-A223305] N90-29507
Piezoelectric and electrostrictive materials for transducer applications, volume 1
[AD-A223560] N90-29668
Piezoelectric and electrostrictive materials for transducer applications, volume 2
[AD-A223561] N90-29669
A study of water vapor, electrical parameters, and radio propagation
[AD-A223582] N90-29736
Angle sample variance of azimuthally spread scattering processes, using a two-element array
[AD-A223572] N90-30034
Analysis and synthesis of robust data structures
[AD-A224568] N90-30131

PENNSYLVANIA UNIV., PHILADELPHIA.
Atomistic studies of grain boundaries in alloys and compounds
[DE90-012401] N90-29492
On the stability of robotic systems with random communication rates N90-29665
Absolute wind measurements in the lower thermosphere of Venus using infrared heterodyne spectroscopy N90-30146

PHILIPS GLOEILAMPENFABRIEKEN N.V., EINDHOVEN (NETHERLANDS).
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124

PHILLIPS (ALAN H.), SYOSSET, NY.
The determination of PDOP (Position Dilution of Precision) in GPS N90-29351

PHYSICAL SCIENCES, INC., ANDOVER, MA.
Laser induced fluorescence: Practical applications N90-29323

PHYSICS AND ELECTRONICS LAB. TNO, THE HAGUE (NETHERLANDS).
Study improvement training facilities ground control air traffic controllers. Part 1: Alternative solutions and their consequences
[FEL-89-A257-PT-1] N90-29380
Study improvement training facilities ground control air traffic controllers. Part 2: Functional analysis approach control trainer
[FEL-89-A280-PT-2] N90-29409
Investigation method for AA-proximity fuses
[FEL-89-A194] N90-29535
SONA: A measurement system for the determination of the end-of-flight burst behaviour of projectiles equipped with proximity fuses
[FEL-89-A293] N90-29536
Neural networks and radar systems
[FEL-89-B65] N90-29558
Detectors and signal processing for the speed measuring system 4-01
[FEL-1989-64] N90-29623

PISA UNIV. (ITALY).
Sensor-based fine telemanipulation for space robotics N90-29841

PITTSBURGH UNIV., PA.
A posteriori error estimates for parametrized nonlinear equations
[AD-A224067] N90-29997

POLITECNICO DI MILANO (ITALY).
A single wafer bit-sliced convolver: An optimum statistical solution for the implementation of redundancy
[REPT-89-019] N90-29584
Macro cell placement with neural net algorithms
[REPT-90-020] N90-29585
Elastic interfaces
[REPT-90-003] N90-29742
Redundant sensorized arm+hand system for space telerobotized manipulation N90-29792
Redundancy in sensors, control and planning of a robotic system for space telerobotics N90-29847
Directing an animated scene with autonomous actors
[REPT-89-041] N90-29972
Formal semantics of SQL queries
[REPT-89-069] N90-29973

PRINCETON UNIV., NJ.
Chemical kinetic and aerodynamic structures of flames
[AD-A224281] N90-29455
Short encodings of evolving structures
[AD-A223641] N90-29944
A parallel least squares collocation conjugate gradient approach for the advection diffusion equation
[DE90-015965] N90-29961
Unique binary search tree representations and equality-testing of sets and sequences
[AD-A223643] N90-30002

PRINS MAURITS LAB. TNO, RIJSWIJK (NETHERLANDS).
Solid fuel combustion chamber
[LR-634] N90-29433

PROGRAM DEVELOPMENT CORP., WHITE PLAINS, NY.
Local interpolation functions for curve generation with the multi-surface transformation N90-29608
The control point form of algebraic grid generation N90-29609
The fundamentals of adaptive grid movement N90-29610

PUERTO RICO UNIV., RIO PIEDRAS.
Effects of basis set contraction in relativistic calculations on neon, argon, and germanium
[AD-A223357] N90-29460

PURDUE UNIV., WEST LAFAYETTE, IN.
Basic studies of 3-V high efficiency cell components
[DE90-000360] N90-29696
Weighted feature selection criteria for visual servoing of a telerobot N90-29801
Classical and Bayes-P subset selection procedures for double exponential populations
[AD-A223830] N90-30006
The II-VI semiconductor superlattices
[AD-A223748] N90-30101

Q

QUEENS UNIV., KINGSTON (ONTARIO).
RCTS: A flexible environment for sensor integration and control of robot systems; the distributed processing approach N90-29852

R

RADEX, INC., BEDFORD, MA.
NASA radiation belt models AP-8 and AE-8
[AD-A223660] N90-29737

READING UNIV. (ENGLAND).
Coordination of mesoscale meteorological research between ASL and European groups
[AD-A223811] N90-29751

REGIS COLL., WESTON, MA.
Effects of energy, momentum and particle transport in the near-earth solar terrestrial system
[AD-A224393] N90-29726

RENSSELAER POLYTECHNIC INST., TROY, NY.
Research on mercury cadmium telluride
[AD-A224250] N90-29474
Using multiple sensors for printed circuit board insertion N90-29867
Effect of a crystal-melt interface on Taylor-Vortex flow with buoyancy
[PB90-244401] N90-30089
An advanced single event upset tester
[AD-A223613] N90-30163

RHODE ISLAND UNIV., KINGSTON.
Performance analysis of subspace-based parameter estimation algorithms
[AD-A224523] N90-29566
Adaptive, robust, high-resolution signal processing
[AD-A223728] N90-30004

RICE UNIV., HOUSTON, TX.
Optimal trajectories for hypervelocity flight N90-29378
A global model of thunderstorm electricity and the prediction of whistler duct formation N90-29744
Windshear estimation along the trajectory of an aircraft N90-29745

RIKKYO UNIV., TOKYO (JAPAN).
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164

ROCHESTER UNIV., NY.
Transition metal activation and functionalization of carbon-hydrogen bonds
[DE90-015826] N90-29489
Reactive behavior, learning, and anticipation N90-29908
Effects and control of the correlation properties of light sources
[AD-A224539] N90-30049

ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA.
Integrated controls and health monitoring fiberoptic shaft monitor
[NASA-CR-185210] N90-29622

ROCKWELL INTERNATIONAL CORP., CEDAR RAPIDS, IA.
High speed bus technology development
[AD-A224486] N90-29585

ROCKWELL INTERNATIONAL CORP., GOLDEN, CO.
Non-contact contour gage
[DE90-014672] N90-29642

ROCKWELL INTERNATIONAL SCIENCE CENTER, THOUSAND OAKS, CA.
Processability and high temperature behavior of emerging aerospace alloys
[AD-A224285] N90-29475

ROME AIR DEVELOPMENT CENTER, GRIFFISS AFB, NY.
Reliability study of TWT output RF window
[AD-A223688] N90-29574

ROYAL AEROSPACE ESTABLISHMENT, FARNBOROUGH (ENGLAND).
Satellite motion in an axi-symmetric gravitational field. Part 1: Perturbations due to J2 (second order) and J3
[RAE-TR-88068] N90-29429
Re-analysis of data on the space radiation environment above southeast Asia
[AD-A224155] N90-30162
Re-analysis of data on the space radiation environment above south-east Asia
[RAE-TR-89048] N90-30166

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH (ENGLAND).
The experimental investigation of flow in the core of a vortex structure
[BR114893] N90-29597
The investigation and production of titanium-tantalum junctions diffusion bonded at high temperature (855 C to 920 C): The influence of temperature, time pressure and roughness on the mechanical properties, and the optimisation of the bonded conditions
[BR114894] N90-29646

ROYAL MILITARY COLL. OF SCIENCE, SHRIVENHAM (ENGLAND).
The optimum polymer binder for pressable high performance explosives: A preliminary evaluation
[ETN-90-97612] N90-29524

ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.
The effects of a doubling of atmospheric CO2 on the stormtracks in the climate of a general circulation model
[KNMI-WR-90-01] N90-29713
The effect of wave data assimilation on the numerical simulation of wave energy advection
[KNMI-TR-121] N90-29760

ROYAL SIGNALS AND RADAR ESTABLISHMENT, MALVERN (ENGLAND).
Theoretical and experimental comparison of infrared and visible laser scattering from a variety of surface types
[RSRE-MEMO-4348] N90-29636
Asymptotic code vector density in topographic vector quantisers
[RSRE-MEMO-4392] N90-30012
Quantum well infrared detectors 1: Some calculations of their optical properties
[RSRE-MEMO-4363] N90-30062
Parametric testing for the RSRE CMOS, silicon on sapphire process
[RSRE-MEMO-4369] N90-30115

S

SAN DIEGO STATE UNIV., CA.
Kinematic sensitivity of robot manipulators N90-29863
Special purpose spatial light modulators
[AD-A223794] N90-30052

SANDIA NATIONAL LABS., ALBUQUERQUE, NM.
A land navigation demonstration vehicle with a color map display for tactical use N90-29375

User's manual for the Trajectory Simulation and Analysis Program (TSAP)
[DE90-014850] N90-29426
Thermochemical data for silicon-containing species from ab initio electronic structure calculations
[DE90-011024] N90-29463
A welding metallurgy study of Hastelloy Alloys B-2 and W
[DE90-011910] N90-29481
Kinetics and structure of silicate sol-gels
[DE90-015702] N90-29521
Long pulse diode experiments
[DE90-016218] N90-29578
A viscoelastic material model for computing stresses in glass
[DE90-014851] N90-29673
Electronic and photonic power applications
[DE90-015567] N90-29698
An alternative control structure for telerobotics N90-29889
Oxygen deficiency monitor system
[DE90-014866] N90-29917
Ray traced scalar fields with shaded polygonal output
[DE90-011023] N90-29955
A compact real-time acousto-optic image correlator
[DE90-015564] N90-30054
Small multipurpose stored data acquisition system
[DE90-010823] N90-30134
Integration of information systems components
[DE90-011761] N90-30136

SANDIA NATIONAL LABS., LIVERMORE, CA.
Electron-beam fluorescence measurements in hypersonic flows N90-29318

SAO PAULO UNIV. (BRAZIL).
Structure of magnetic field in tokamaks
[DE90-628904] N90-30075
Magnetic surfaces in tokamaks
[DE90-628905] N90-30076

SCIENCE APPLICATIONS INTERNATIONAL CORP., MCLEAN, VA.
High average power CW FELS (Free Electron Laser) for application to plasma heating: Designs and experiments
[DE90-011085] N90-29633
System software for Soviet computers N90-29921

SCIENCE RESEARCH CORP., SOMERVILLE, MA.
Development of an all solid state 6 kHz pulse generator for driving free electron laser amplifiers
[AD-A224105] N90-29561

SCRIPPS INSTITUTION OF OCEANOGRAPHY, SAN DIEGO, CA.
Proceedings of a Workshop on the Geoelectric and Geomagnetic Environment of Continental Margins
[AD-A223743] N90-29739

SINGER CO., LITTLE FALLS, NJ.
Use of a three-axis monolithic ring laser gyro and digital signal processor in an inertial sensor element N90-29354
Integrated strapdown avionics for precision guided vehicles N90-29361

SINGER CO., WAYNE, NJ.
The integration of multiple avionic sensors and technologies for future military helicopters N90-29344

SOCIETE BERTIN ET CIE, PLAISIR (FRANCE).
Experimental study on the dynamic behavior of a revolving blade grill
[REPT-NT-89-CC-18] N90-29604

SOUTH CAROLINA UNIV., COLUMBIA.
Thermal analyses of power subsystem components
[NASA-CR-186314] N90-29637

SOUTHAMPTON UNIV. (ENGLAND).
Activities report of the Institute of Sound and Vibration Research
[ETN-90-97604] N90-30170

SOUTHERN METHODIST UNIV., DALLAS, TX.
Saddlepoint approximations in conditional inference
[AD-A223280] N90-30000

SPECTRAL SCIENCES, INC., BURLINGTON, MA.
Thermal imaging assessment
[AD-A224400] N90-29542

SRI INTERNATIONAL CORP., MENLO PARK, CA.
Satellite measurements of magnetospheric Poynting flux
[AD-A224391] N90-29724

ST SYSTEMS CORP., LANHAM, MD.
Impedance hand controllers for increasing efficiency in teleoperations N90-29793

STANFORD UNIV., CA.
Techniques for autonomous GPS integrity monitoring N90-29345
Sample rate effects on disturbance rejection for digital control systems N90-29400
Laser physics and laser spectroscopy
[AD-A224379] N90-29628
Spectral structure and generation mechanism of ducted VLF whistler mode sideband waves N90-29720
Experiments in cooperative manipulation: A system perspective N90-29812
Instruction dialogues: Teaching new skills to a robot N90-29884
Computed torque control of a free-flying cooperating-arm robot N90-29898
New approaches to linear and nonlinear programming
[AD-A224328] N90-29932
Asynchronous design for parallel processing architectures
[AD-A223754] N90-29981
Hitting lines with two-dimensional Brownian motion
[AD-A223595] N90-30027
The computation and analysis of acoustic waves in transonic airfoil-vortex interactions N90-30031
Scanning tunneling microscopy of semiconductor surfaces
[AD-A223339] N90-30095

STATE UNIV. OF NEW YORK, BUFFALO.
Soft x ray contact imaging of biological specimens using a laser-produced plasma as an x ray source
[DE90-016098] N90-30082

STATE UNIV. OF NEW YORK, STONY BROOK.
Study of the reflection of surface acoustic wave from a material discontinuity boundary using a perturbation method N90-30032

SYRACUSE UNIV., NY.
Analysis of a TM01 circular to TE10 rectangular waveguide mode converter
[AD-A224566] N90-29568

SYSTEMS EXPLORATION, INC., SAN DIEGO, CA.
Sounder update and field strength software modifications for Special Operations Radio Frequency Management System (SORFMS). Volume 1: Program descriptions and testing
[AD-A224510] N90-29543

T

TECHNICAL RESEARCH CENTRE OF FINLAND, ESPOO.
The ACR-program for automatic finite element model generation for part through cracks
[DE90-631545] N90-29662

TECHNION RESEARCH AND DEVELOPMENT FOUNDATION LTD., HAIFA (ISRAEL).
Multi-disciplinary optimization of aeroservoelastic systems
[NASA-CR-185931] N90-29385

TECHNISCHE HOCHSCHULE, DARMSTADT (GERMANY, F.R.).
Fact system: A standardizing modelization processing for concurrent systems
[ETN-90-97286] N90-29982
Hyperbolic Hjelmslev groups
[ETN-90-97298] N90-30009
For the definition of two person zero sum games
[ETN-90-97294] N90-30022
Emission of quick neutrons and non-equilibrium phenomena by central shocks in the reaction 40 Ar + 40 Ca at 20 MeV/u
[ETN-90-97296] N90-30043
Image amplification in photoreactive crystals and utilization in optical reaction systems
[ETN-90-97285] N90-30059

TECHNISCHE HOGESCHOOL, EINDHOVEN (NETHERLANDS).
Book of abstracts of the 1st Benelux-Japan Workshop on Information and Communication Theory
[PB90-191446] N90-30124

TECHNISCHE UNIV., BERLIN (GERMANY, F.R.).
Examinations of hyperfine structure and isotope displacement of the elements gadolinium and europium with laser fluorescence and two photon spectroscopy
[ETN-90-97312] N90-29488
Theoretical and experimental examinations of brushless monophase direct current motors
[ETN-90-97301] N90-29580
Utilization of a measurement process by the examination of universal motors
[ETN-90-97307] N90-29581
Optical nonlinearity due to structure defects and bistability in the band discontinuity area of CdS
[ETN-90-97303] N90-30112
Manufacturing and characterization of liquid-phase epitaxy layers with atomic levels at the crystal surface and at the hetero limit surfaces in the system GaAs-AlGaAs
[ETN-90-97310] N90-30113
Extended characterization of the damage by hot charge carriers in gate oxide by short channel MOS field effect transistors
[ETN-90-97313] N90-30114

TECHNISCHE UNIV., DELFT (NETHERLANDS).
Tests for aircraft interior materials in fire accident
[LR-622] N90-29337
WingDesign: Program for the structural design of a wing cross-section
[LR-627] N90-29390
Solid fuel combustion chamber
[LR-634] N90-29433
Interlaminar shear tests on continuous fiber reinforced thermoplastics: The effects of rubber forming
[LR-621] N90-29451
Buckling of anisotropic cylindrical shells subjected to combined axial compression, normal pressure, bending and shear loading
[LR-611] N90-29678
An investigation of hole-edge crack problem by a combined complex variable and least square method
[LR-626] N90-29679
Fractographic analysis of fatigue crack growth under two-blocks loading on 2024-T351 sheet specimens
[LR-628] N90-29680
Effects of blocks of overloads and underloads on fatigue crack growth in 2024-T351 sheet specimens: Fractographic analysis and crack closure predictions
[LR-629] N90-29681
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 1: Text
[LR-630-PT-1-REV] N90-29682
Fatigue, static tensile strength and stress corrosion of aircraft materials and structures. Part 2: Figures
[LR-630-PT-2] N90-29683
Fractographic observations on fatigue crack growth under miniTWIST flight-simulation loading (2024-T3 material)
[LR-631] N90-29684
Recent developments in shell stability analysis
[LR-633] N90-29685
Frequency and ventilation: A survey of theoretical and experimental ventilation modelling
[LR-625] N90-29772
Solution of nonlinear eigenvalue problems via parallel shooting
[LR-587] N90-30013

TECNOSPAZIO S.P.A., MILAN (ITALY).
Space robotic system for proximity operations N90-29806
A collision avoidance system for a spaceplane manipulator arm N90-29903

TENNESSEE UNIV., KNOXVILLE.
Robotic control of the seven-degree-of-freedom NASA laboratory telerobotic manipulator N90-29870

TEXAS A&M UNIV., COLLEGE STATION.
Barotropic mechanisms associated with tropical plume formation N90-29719
Three-dimensional numerical study of thunderstorm downdrafts and associated outflow boundaries N90-29746
Unification of statistical methods for continuous and discrete data
[AD-A224307] N90-30017
Time series, statistics, and information
[AD-A224317] N90-30018

TEXAS UNIV., ARLINGTON.
Magnetostatic wave transducers, resonators and dispersion control
[AD-A223437] N90-29571

TEXAS UNIV., AUSTIN.
Toughening of SAN copolymers by an SAN emulsion grafted rubber
[AD-A224213] N90-29502
Microwave active filters based on coupled negative resistance method
[AD-A223269] N90-29570

TEXAS UNIV., SAN ANTONIO.
Multi-user facility for high performance optical recording of brain activity (DURIP)
[AD-A223491] N90-29768

TEXAS UNIV. AT DALLAS, RICHARDSON.
Studies of ionospheric dynamics utilizing data from DMSP
[AD-A223370] N90-29733

TOKYO INST. OF TECH. (JAPAN).
Experimental study on two-dimensional free-flying robot satellite model N90-29896

TOKYO UNIV. (JAPAN).
Manipulators with flexible links: A simple model and experiments N90-29786
Detector to study low-flex hard x ray/gamma ray sources
[UT-HE-90/08] N90-30164
New developments in low-energy cosmic gamma-ray detection
[UT-HE-90/07] N90-30165

TOKYO UNIV., TANASHI (JAPAN).
The t2 dominance of the energy-momentum tensor
[DE90-508027] N90-29544
A new vector-tensor theory and higher-dimensional cosmology
[DE90-507990] N90-30117

Workshop on Low-Dimensional Quantum Field Theory and its Applications
[DE90-508071] N90-30118
Search for neutrino events in the Kamiokande-2 detector in correlation with the solar-flare activity in Marcn 1989
[DE90-508085] N90-30160

TORONTO UNIV., DOWNSVIEW (ONTARIO).
Recursive multibody dynamics and discrete-time optimal control N90-29860

TOSHIBA CORP., KAWASAKI (JAPAN).
Capture of free-flying payloads with flexible space manipulators N90-29784

TRIMBLE NAVIGATION, SUNNYVALE, CA.
Combining LORAN and GPS: The best of both worlds N90-29343

TRW DEFENSE AND SPACE SYSTEMS GROUP, REDONDO BEACH, CA.
Generalized Advanced Propeller Analysis System (GAPAS). Volume 2: Computer program user manual
[NASA-CR-185277] N90-29394

TRW DEFENSE AND SPACE SYSTEMS GROUP, SAN DIEGO, CA.
Distributed control architecture for CNI preprocessors N90-29356

TSUKUBA SPACE CENTER (JAPAN).
Next generation space robot N90-29899

TULANE UNIV., NEW ORLEANS, LA.
A control approach for robots with flexible links and rigid end-effectors N90-29879

U

UNITED TECHNOLOGIES CORP., EAST HARTFORD, CT.
Development of dual fiber reinforced glass matrix composites for structural space based applications
[AD-A223801] N90-29446

UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CT.
Investigation of particulate formation during diesel spray combustion
[DE90-012682] N90-29464
Investigation of laser diagnostics of PACVO (Plasma Assisted Chemical Vapor Deposition) processes for depositing hard face coatings
[DE90-016209] N90-29522

UNIVERSAL ENERGY SYSTEMS, INC., DAYTON, OH.
Tool for studying the effects of range restriction in correlation coefficient estimation
[AD-A224035] N90-29996

UNIVERSITY COLL., LONDON (ENGLAND).
Atmospheric structure and variability
[AD-A223439] N90-29734

UNIVERSITY COLL. OF SWANSEA (WALES).
Grid generation N90-29607

UNIVERSITY OF SOUTH FLORIDA, TAMPA.
Search strategies for computer-stored information: A microcomputer tutorial N90-30126

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Processing of polymers using supercritical fluids
[AD-A223681] N90-29514
Autonomous dexterous end-effectors for space robotics N90-29788

UNIVERSITY OF SOUTHERN ILLINOIS, CARBONDALE.
An improved adaptive control for repetitive motion of robots N90-29831

UNIVERSITY OF SOUTHERN MISSISSIPPI, HATTIESBURG.
Solid-state N15 NMR of N15-labeled nylon 6 and nylon 11
[AD-A223271] N90-29459

UTAH UNIV., SALT LAKE CITY.
Mechanism of habit change for atmospheric ice crystal growth N90-29717
Linear analysis of a force reflective teleoperator N90-29856

V

VIGYAN RESEARCH ASSOCIATES, INC., HAMPTON, VA.
A package for 3-D unstructured grid generation, finite-element flow solution and flow field visualization
[NASA-CR-182090] N90-29309

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
On a generalized laminate theory with application to bending, vibration, and delamination buckling in composite laminates N90-29659

VIRGINIA UNIV., CHARLOTTESVILLE.
Non-destructive method for environmental breakdown of graphite fiber reinforced polymer composites
[AD-A223729] N90-29515
A lunar space station
[NASA-CR-186223] N90-30158

VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE (BELGIUM).
Measurement Techniques for Hypersonic Flows
[VKI-LS-1990-05] N90-29314
Numerical Grid Generation
[VKI-LS-1990-06] N90-29606

W

WASHINGTON STATE UNIV., PULLMAN.
Wind tunnel, field, and numerical investigations of plume downwash and dispersion at an arctic industrial site N90-29721

WASHINGTON UNIV., SEATTLE.
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016127] N90-29962
Computing environments, interactive graphics and nonparametric methods for data analysis
[DE90-016128] N90-29964
Adiabatic invariance and transient resonance in very slowly varying oscillatory Hamiltonian systems
[DE90-016118] N90-30007
Compact toroid research
[DE90-016123] N90-30087

WESTINGHOUSE DEFENSE AND ELECTRONIC SYSTEMS CENTER, BALTIMORE, MD.
Guidance and control techniques for airborne transfer alignment and SAR motion compensation N90-29372

WESTINGHOUSE ELECTRIC CORP., BALTIMORE, MD.
Reliability analysis/assessment of advanced technologies
[AD-A223647] N90-29573

WESTINGHOUSE ELECTRIC CORP., MADISON, PA.
Model based manipulator control N90-29833

WISCONSIN UNIV., MADISON.
Kinetic pathway in Stranski-Krastanov growth of Ge on Si(001)
[AD-A224324] N90-29456
Extension of plasma source ion implantation to ion beam enhanced deposition
[AD-A224462] N90-29506
An analysis of the characteristics of atmospheric profiles obtained with the High resolution Interferometer Sounder (HIS) N90-29716
Microscopic aspects of the initial stages of epitaxial growth. A scanning tunneling microscopy study
[AD-A224325] N90-30094

WOODS HOLE OCEANOGRAPHIC INST., MA.
Improved meteorological measurements from buoys and ships (IMET): Preliminary report on barometric pressure sensors
[PB90-242116] N90-29748
Rates of vertical mixing, gas exchange, and new productions: Estimates from seasonal gas cycles in the upper ocean near Bermuda
[PB90-244781] N90-29758

WRIGHT RESEARCH DEVELOPMENT CENTER, WRIGHT-PATTERSON AFB, OH.
Proceedings of damping '89. Volume 1: Pages AAB-1 through DCD-11
[AD-A223431] N90-29664
Proceedings of damping '89. Volume 2: Pages FAA-1 through IBD-15
[AD-A223432] N90-29665
Proceedings of Damping '89. Volume 3: Pages ICA-1 through KDC-15
[AD-A223433] N90-29666
Software development: A product life-cycle perspective
[AD-A223783] N90-29952

WRIGHT STATE UNIV., DAYTON, OH.
A VHDL interface for Altera design files
[AD-A224476] N90-29920

WYATT TECHNOLOGY CO., SANTA BARBARA, CA.
Submicron particle analyzer
[AD-A223558] N90-30050

WYLE LABS., INC., HAMPTON, VA.
Realtime multi-plot graphics system
[NASA-CR-4304] N90-29919

Y

YALE UNIV., NEW HAVEN, CT.
Strategies for tutoring multiple bugs
[AD-A223921] N90-29927
Fast algorithms for parallel architectures
[AD-A223731] N90-29947
An observational study of disk-population globular clusters N90-30145
The evolution of horizontal branch stars and the calibration of globular cluster ages N90-30152

Typical Contract Number Index Listing

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

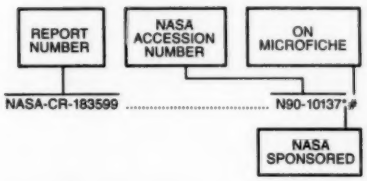
AF PROJ. 9A10 ..... N90-29731
AF PROJ. 486U N90-29684
N90-29685
N90-29686
AF PROJ. 1068 ..... N90-30130
AF PROJ. 2003 ..... N90-29952
AF PROJ. 2301 ..... N90-29628
N90-30065
N90-30096
AF PROJ. 2302 ..... N90-29386
N90-29439
N90-29445
N90-29661
AF PROJ. 2303 ..... N90-29507
N90-29695
AF PROJ. 2304 ..... N90-29653
N90-29939
N90-29940
N90-29980
N90-30001
N90-30019
N90-30021
N90-30039
AF PROJ. 2305 ..... N90-29552
N90-30051
AF PROJ. 2306 ..... N90-30101
AF PROJ. 2307 ..... N90-29595
AF PROJ. 2308 ..... N90-29455
N90-29590
N90-29596
AF PROJ. 2310 ..... N90-29723
N90-29749
N90-30040
AF PROJ. 2312 ..... N90-29764
N90-29765
AF PROJ. 2313 ..... N90-29774
N90-29775
N90-29776
AF PROJ. 2338 ..... N90-29573
AF PROJ. 2373 ..... N90-29458
AF PROJ. 2418 ..... N90-29387
AF PROJ. 2480 ..... N90-29527
AF PROJ. 2567 ..... N90-29307
AF PROJ. 2688 ..... N90-29618
AF PROJ. 2734 ..... N90-29585
AF PROJ. 3037 ..... N90-30036
AF PROJ. 3066 ..... N90-29396
N90-29667
AF PROJ. 3484 ..... N90-30064
AF PROJ. 3842 ..... N90-29768
AF PROJ. 4643 ..... N90-29723
N90-29730
AF PROJ. 5797 ..... N90-30067
AF PROJ. 6177 ..... N90-29540
AF PROJ. 7600 ..... N90-29735
AF PROJ. 7659 ..... N90-29737
AF-AFOSR-0029-88 ..... N90-29661
AF-AFOSR-0032-89 ..... N90-29940
AF-AFOSR-0090-87 ..... N90-29817
AF-AFOSR-0117-88 ..... N90-29939
AF-AFOSR-0118-89 ..... N90-29768
AF-AFOSR-0119-89 ..... N90-29980
AF-AFOSR-0155-88 ..... N90-29596
AF-AFOSR-0185-85 ..... N90-30101
AF-AFOSR-0185-88 ..... N90-30001
AF-AFOSR-0189-86 ..... N90-30051
AF-AFOSR-0191-88 ..... N90-29764
AF-AFOSR-0196-87 ..... N90-29932
AF-AFOSR-0200-86 ..... N90-29458
AF-AFOSR-0206-89 ..... N90-29774
AF-AFOSR-0208-86 ..... N90-29653
AF-AFOSR-0213-83 ..... N90-29596
AF-AFOSR-0217-87 ..... N90-30065
AF-AFOSR-0241-88 ..... N90-29305
AF-AFOSR-0242-87 ..... N90-29445
AF-AFOSR-0242-89 ..... N90-29776
AF-AFOSR-0255-82 ..... N90-29904
AF-AFOSR-0280-85 ..... N90-30096
AF-AFOSR-0281-89 ..... N90-29595
AF-AFOSR-0287-88 ..... N90-29552
AF-AFOSR-0288-89 ..... N90-29439
AF-AFOSR-0293-89 ..... N90-29455
AF-AFOSR-0307-86 ..... N90-29610
AF-AFOSR-0311-89 ..... N90-29540
AF-AFOSR-0330-89 ..... N90-29731
AF-AFOSR-0345-86 ..... N90-30064
AF-AFOSR-0354-88 ..... N90-29628
AF-AFOSR-0392-89 ..... N90-29590
ARPA ORDER 5299 ..... N90-29731
ARPA ORDER 5378 ..... N90-29977
ARPA ORDER 5794 ..... N90-29931
ARPA ORDER 6631 ..... N90-30053
A79/KL/095 ..... N90-29623
A81/KL/121 ..... N90-29536
A86/KM/110 ..... N90-29535
A88/KLU/621 ..... N90-29380
N90-29409
BMFT-KF-3009/2 ..... N90-29754
CCA8309/188 ..... N90-29867
CMU-406349-55586 ..... N90-29883
DA PROJ. CJ8-29178-CJCA N90-30053
DA PROJ. 1A9-3Z9-CANMSC N90-29477
DA PROJ. 1C1-62622-A-552 ..... N90-30048
DA PROJ. 1C1-62622-A-5531 ..... N90-29454
DA PROJ. 1L1-62716-AH-70 ..... N90-30020
N90-30133
DA PROJ. 3E1-62787-A-879 ..... N90-29769
DA PROJ. 4A1-62731-AT-41 ..... N90-29531
DAAA15-85-C-006 ..... N90-30050
DAAA19-87-0094 ..... N90-29877
DAAB07-76-C-1750 ..... N90-29358
DAAB07-82-C-J096 ..... N90-29359
DAAB07-89-C-F404 ..... N90-30053
DAAG29-84-K-0136 ..... N90-29438
DAAG29-85-G-0118 ..... N90-29460
DAAG29-85-K-0045 ..... N90-29539
DAAG29-85-K-0137 ..... N90-29515
DAAL02-88-K-0056 ..... N90-29568
DAAL03-86-G-0029 ..... N90-29947
DAAL03-86-K-0094 ..... N90-30016
DAAL03-86-K-0106 ..... N90-30004
DAAL03-86-K-0173 ..... N90-30049
DAAL03-87-K-0053 ..... N90-29627
DAAL03-87-K-0059 ..... N90-29538
DAAL03-88-C-0006 ..... N90-29302
DAAL03-88-K-0004 ..... N90-29502
DAAL03-88-K-0005 ..... N90-29570
DAAL03-88-K-0199 ..... N90-29505
DAAL03-89-C-0022 ..... N90-30097
DAAL03-89-G-0020 ..... N90-29457
DAAL03-89-K-0048 ..... N90-29506
DAAL03-90-G-0037 ..... N90-29304
DAAL03-90-G-0069 ..... N90-30017
N90-30018
DACA76-85-C-0010 ..... N90-29929
N90-29945
DACA76-85-K-0685 ..... N90-29985
DACA88-90-0003 ..... N90-29645
DAJA45-86-C-0029 ..... N90-29528
DAJA45-90-C-0009 ..... N90-29751
DAJA45-90-M-0093 ..... N90-29575
DAJA45-90-M-0273 ..... N90-29476
DAMD17-88-C-8054 ..... N90-29769
DE-AC02-76CH-00016 ..... N90-29494
N90-29599
N90-30058
DE-AC02-78ET-51013 ..... N90-30086
DE-AC02-80ET-15601 ..... N90-30083
DE-AC02-83CH-10093 ..... N90-29308
N90-29696
N90-29697
DE-AC02-85NE-37947 ..... N90-29833
DE-AC03-76SF-00098 ..... N90-29447
N90-29449
N90-29466
N90-29486
N90-29699
N90-30103
N90-30105
N90-30106
N90-30107
N90-30108
N90-30155
DE-AC04-76DP-00613 ..... N90-29523
DE-AC04-76DP-00789 ..... N90-29426
N90-29463
N90-29481
N90-29520
N90-29521
N90-29578
N90-29641
N90-29673
N90-29698
N90-29889
N90-29917
N90-29955
N90-30054
N90-30134
N90-30136
DE-AC04-76DP-03533 ..... N90-29642
DE-AC04-87AL-43058 ..... N90-29464
DE-AC04-88DP-43495 ..... N90-29529
N90-29530
N90-29534
N90-29635
DE-AC05-84OR-21400 ..... N90-29448
N90-29488
N90-29490
N90-29491
N90-29493
N90-29500
N90-29519
N90-29532
N90-29579
N90-29598
N90-29647
N90-29649
N90-29656
N90-29672
N90-29674
N90-29712
N90-29869
N90-29870
N90-29960
N90-30110
N90-30135
DE-AC05-84OT-21400 ..... N90-29963
DE-AC06-76RL-01830 ..... N90-29472
N90-29484
N90-29485
N90-29495
N90-29496
N90-30057
N90-30104
N90-30139
DE-AC07-76ID-01570 ..... N90-29452
N90-29652
DE-AC07-84ID-12435 ..... N90-29648
DE-AC09-76SR-00001 ..... N90-29616
DE-AC22-89BC-14200 ..... N90-29467
DE-AS03-88DP-10782 ..... N90-30082
DE-FC22-83FE-60149 ..... N90-29527
DE-FG02-86ER-13463 ..... N90-29453
DE-FG02-86ER-13560 ..... N90-29522
DE-FG02-86ER-13569 ..... N90-29489
DE-FG02-86ER-25013 ..... N90-29959
DE-FG02-86ER-52127 ..... N90-30084

N90-30085
DE-FG02-86ER-60453 ..... N90-29961
DE-FG02-87ER-25026 ..... N90-30008
DE-FG02-87ER-45295 ..... N90-29492
DE-FG02-88ER-40415 ..... N90-30042
DE-FG02-88ER-53263 ..... N90-30080
DE-FG02-89ER-40531 ..... N90-30037
DE-FG02-90ER-60932 ..... N90-29710
DE-FG05-87ER-52147 ..... N90-29633
DE-FG06-85ER-25006 ..... N90-29962
N90-29964
DE-FG06-86ER-13530 ..... N90-29741
DE-FG06-86ER-25019 ..... N90-30007
DE-FG06-87ER-53243 ..... N90-30087
DE-FG22-85PC-80518 ..... N90-29487
DE-FG22-86PC-90534 ..... N90-29465
DFVLR-5-575-4359 ..... N90-29843
DL-H-404160 ..... N90-29671
DLA900-88-D-0392 ..... N90-29406
DNA001-87-C-0169 ..... N90-29554
DRET-85-404 ..... N90-29602
DRET-86-118 ..... N90-29603
DRET-86-332 ..... N90-29601
DRET-87-34-001 ..... N90-29313
DRET-87-439 ..... N90-29604
DRET-88-34-001 ..... N90-29497
N90-29498
N90-29677
DRET-88-1501 ..... N90-29311
DRET-89-34-001 ..... N90-29983
DRET-89-001-23 ..... N90-29312
DRET-89-002-06 ..... N90-29600
DRET-89-003-07 ..... N90-30061
DTFA01-84-C-00001 ..... N90-29364
EPA-DW-89932676-01-1 ..... N90-29709
FMV-82250-86-033-24-001 ..... N90-29675
F04611-86-K-0069 ..... N90-30066
F08635-88-C-0063 ..... N90-29954
F19628-84-K-0029 ..... N90-29571
F19628-85-C-0003 ..... N90-29950
F19628-86-C-0001 ..... N90-29938
F19628-86-C-0105 ..... N90-29725
N90-29730
F19628-86-K-0029 ..... N90-29728
F19628-86-K-0036 ..... N90-29727
F19628-86-K-0038 ..... N90-29723
F19628-86-K-0044 ..... N90-29724
F19628-86-K-0045 ..... N90-29726
F19628-87-K-0008 ..... N90-30129
F19628-87-K-0012 ..... N90-29729
F19628-87-K-0014 ..... N90-29733
F19628-87-K-0045 ..... N90-30153
F19628-87-K-0052 ..... N90-30040
F19628-88-K-0042 ..... N90-30000
F19628-89-C-0001 ..... N90-29988
F19628-89-C-0003 ..... N90-29379
N90-29949
N90-30005
F19628-89-C-0068 ..... N90-29737
F19628-90-C-0002 ..... N90-29546
N90-29547
N90-29953
F19682-88-C-0074 ..... N90-29542
F29001-86-C-0216 ..... N90-30067
F30602-81-C-0206 ..... N90-29818
F30602-85-C-0010 ..... N90-29817
N90-29904
F30602-86-C-0116 ..... N90-29943
F30602-87-C-0186 ..... N90-29573
F30602-88-C-0001 ..... N90-29816
F30602-88-D-0028 ..... N90-29562
N90-30130
F33615-83-C-1036 ..... N90-29585
F33615-85-C-2585 ..... N90-29396
N90-29667
F33615-86-C-0530 ..... N90-30035
F33615-86-C-5031 ..... N90-29387
F33615-87-C-0012 ..... N90-29407
F33615-87-D-0626 ..... N90-29765
F33615-89-C-5628 ..... N90-29463
F49620-85-C-0144 ..... N90-30019
N90-30021
N90-30039
F49620-86-C-0040 ..... N90-29386
F49620-86-C-0058 ..... N90-29475
F49620-86-C-0082 ..... N90-29931
F49620-87-C-0096 ..... N90-29734
F49620-88-C-0059 ..... N90-30100
F49620-88-C-0074 ..... N90-29507
F49620-88-K-0004 ..... N90-29775
F49620-89-C-0096 ..... N90-29609
F33615086-C-0530 ..... N90-30036
GRI-5084-260-1108 ..... N90-29693
GRI-5086-260-1229 ..... N90-29699
HL-38776 ..... N90-29904
JPL-956501 ..... N90-29788
LM-00083 ..... N90-29904
MDA903-85-C-0124 ..... N90-29977
MDA972-88-J-1006 ..... N90-30102
N90-30108
MIPR-ARO-103-89 ..... N90-29732
MIPR-FY1455-86-N0657 ..... N90-29527
MMES-40-1553-85 ..... N90-29790
NAGW-478 ..... N90-29611
NAGW-1333 ..... N90-29667
NAGW-1340 ..... N90-29556
N90-29557
N90-29740
N90-30041
NAGW-1708 ..... N90-29385
NAGW-1809 ..... N90-29611
NAG1-720 ..... N90-29787
NAG2-308 ..... N90-29777
NAG2-493 ..... N90-29863
NAG2-513 ..... N90-29925
NAG2-593 ..... N90-29922
N90-29975
N90-29976
N90-29977
NAG3-715 ..... N90-29610
NAG5-1019 ..... N90-29861
NAG5-753 ..... N90-29470
NAG9-311 ..... N90-29637
NASW-4435 ..... N90-29381
N90-30158
NAS1-17820 ..... N90-30045
NAS1-18304 ..... N90-29919
NAS1-18599 ..... N90-29363
NAS1-18670 ..... N90-29309
NAS1-18798 ..... N90-29424
NAS1-18864 ..... N90-29423
NAS1-19000 ..... N90-29363
N90-29384
N90-29615
NAS2-10547 ..... N90-29761
NAS3-22251 ..... N90-29394
NAS3-23773 ..... N90-29622
NAS5-28561 ..... N90-29793
NAS7-918 ..... N90-29780
N90-29830
N90-29874
NAS8-37855 ..... N90-30143
NAS9-1900 ..... N90-29890
NAS9-17229 ..... N90-29808
NAS9-17900 ..... N90-29857
N90-29882
NAS9-17973 ..... N90-29430
NATO-0877-87 ..... N90-29878
NCCW-008 ..... N90-29611
NCC2-333 ..... N90-29898
NCC2-444 ..... N90-29300
NCC2-517 ..... N90-29819
NCC9-16 ..... N90-29425
NR PROJ. S40-5018 ..... N90-29576
NR PROJ. 042-267 ..... N90-30027
NRC-1886-8011-93 ..... N90-29672
NSF CCR-86-58139 ..... N90-29944
NSF CCR-87-02271 ..... N90-30002
NSF CCR-87-10737 ..... N90-29933
NSF CCR-89-02221 ..... N90-30002
NSF CCR-89-06949 ..... N90-30002
NSF CDR-84-21415 ..... N90-29854
NSF CDR-85-22618 ..... N90-29955
NSF CDR-88-03017 ..... N90-29801
NSF CHE-87-12319 ..... N90-29435
N90-29461
NSF DCR-83-20085 ..... N90-29883
NSF DCR-84-12582 ..... N90-29977
NSF DCR-86-02958 ..... N90-29906
NSF DCR-86-05962 ..... N90-29944
N90-30002
NSF DMC-85-18735 ..... N90-29868
NSF DMC-87-19579 ..... N90-29788
NSF DMS-87-02620 ..... N90-30006
NSF DMS-88-06067 ..... N90-29944
NSF DMS-89-04740 ..... N90-29925
NSF DMS-89-11410 ..... N90-30008
NSF ECE-86-07591 ..... N90-29722
NSF IRI-87-96249 ..... N90-29788
NSF IRI-88-19624 ..... N90-30003
NSF MCS-83-10236 ..... N90-29987
NSF MCS-83-12148 ..... N90-29935
NSF OCE-85-01171 ..... N90-29758
NSF OCE-87-09614 ..... N90-29748
NSF STC-88-09648 ..... N90-29944
N00014-79-C-0302 ..... N90-29935
N00014-79-C-0610 ..... N90-29736
N00014-80-C-0364 ..... N90-29483
N00014-82-K-0714 ..... N90-29927
N00014-85-K-0046 ..... N90-30002
N00014-85-K-0124 ..... N90-29929
N90-29945
N90-29978
N90-29985
N00014-85-K-0151 ..... N90-29474
N00014-85-K-0387 ..... N90-29567
N00014-85-K-0405 ..... N90-29670
N00014-85-K-0442 ..... N90-30093
N00014-85-K-0636 ..... N90-29503
N00014-85-K-0646 ..... N90-29591
N00014-86-K-0124 ..... N90-30003
N00014-86-K-0178 ..... N90-29440
N90-29441
N00014-86-K-0685 ..... N90-29929
N00014-86-K-01685 ..... N90-29671
N00014-87-G-0259 ..... N90-29388
N00014-87-K-0129 ..... N90-29883
N00014-87-K-0464 ..... N90-29435
N90-29461
N90-29509
N90-29510
N00014-87-K-0467 ..... N90-29944
N90-30002
N00014-87-K-0517 ..... N90-29513
N00014-87-K-0679 ..... N90-30095
N00014-88-C-0251 ..... N90-29446
N00014-88-C-0398 ..... N90-29581
N00014-88-K-0124 ..... N90-29935
N90-29987
N00014-88-K-0170 ..... N90-30006
N00014-88-K-0366 ..... N90-29511
N90-29512
N00014-88-K-0554 ..... N90-29819
N00014-88-K-0825 ..... N90-29978
N00014-89-C-0134 ..... N90-29738
N00014-89-C-0150 ..... N90-29576
N00014-89-C-0230 ..... N90-29632
N00014-89-J-1164 ..... N90-29759
N00014-89-J-1225 ..... N90-29459
N00014-89-J-1319 ..... N90-29306
N00014-89-J-1627 ..... N90-30027
N00014-89-J-1689 ..... N90-29668
N90-29669
N00014-89-J-1714 ..... N90-30077
N00014-89-J-1734 ..... N90-29444
N00014-89-J-1991 ..... N90-29591
N00014-89-J-3036 ..... N90-29981
N00014-89-J-3063 ..... N90-29514
N00014-89-J-3064 ..... N90-29739
N00014-89-J-3202 ..... N90-29946
N00014-90-C-0124 ..... N90-29998
N00014-90-J-1025 ..... N90-29997
N00014-90-J-1119 ..... N90-29456
N90-30094
N00014-90-J-1175 ..... N90-30021
N00014-90-J-1283 ..... N90-29566
N00014-90-WX-24290 ..... N90-29631
N00039-83-C-0136 ..... N90-29987
N00039-87-C-0251 ..... N90-29944
N00039-88-C-0051 ..... N90-30034
N90-30131
N00140-87-C-8904 ..... N90-29922
N00167-88-WR-80059 ..... N90-29478
N66001-86-D-0079 ..... N90-29543
N66001-87-D-0136 ..... N90-30052
RR-00785 ..... N90-29987
R01-NS22407-01 ..... N90-29908
SRC88-MP-121 ..... N90-29854
W-31-109-ENG-38 ..... N90-29472
N90-29516
N90-29517
N90-29518
N90-30109
W-7405-ENG-36 ..... N90-29752
N90-29778
N90-29924
N90-29956
N90-29958
N90-30156
W-7405-ENG-48 ..... N90-29482
N90-29483
N90-29533
N90-29577
N90-29620
N90-29621
N90-29634
N90-29708
N90-29709
N90-29957
N90-29989
N90-30044
N90-30055
N90-30056
N90-30078
N90-30079
N90-30081
N90-30102
N90-30111

N90-30147
324-02-00 ..... N90-29309
505-61-01-01 ..... N90-29919
505-63-01 ..... N90-29384
505-63-01-05 ..... N90-29450
505-63-51-10 ..... N90-29383
505-66-21-01 ..... N90-29965
N90-30014
506-42-21 ..... N90-29622
585-01-91-01 ..... N90-29423
N90-29424
592-01-11-04 ..... N90-29615
871-00-00-04 ..... N90-30045

REPORT/ACCESSION NUMBER INDEX

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-1989-4 ..... N90-29923 #

AD-A218283 ..... N90-29779 #
AD-A222695 ..... N90-29730 #
AD-A223269 ..... N90-29570 #
AD-A223271 ..... N90-29459 #
AD-A223272 ..... N90-29528 #
AD-A223273 ..... N90-29440 #
AD-A223274 ..... N90-29441 #
AD-A223278 ..... N90-29663 #
AD-A223279 ..... N90-29731 #
AD-A223280 ..... N90-30000 #
AD-A223287 ..... N90-30122 #
AD-A223296 ..... N90-29593 #
AD-A223297 ..... N90-29749 #
AD-A223299 ..... N90-29979 #
AD-A223304 ..... N90-29938 #
AD-A223305 ..... N90-29507 #
AD-A223309 ..... N90-29618 #
AD-A223310 ..... N90-29304 #
AD-A223338 ..... N90-29477 #
AD-A223339 ..... N90-30095 #
AD-A223352 ..... N90-29545 #
AD-A223353 ..... N90-29508 #
AD-A223357 ..... N90-29460 #
AD-A223359 ..... N90-30132* #
AD-A223361 ..... N90-29732 #
AD-A223370 ..... N90-29733 #
AD-A223396 ..... N90-29594 #
AD-A223397 ..... N90-29765 #
AD-A223408 ..... N90-30096 #
AD-A223409 ..... N90-29509 #
AD-A223411 ..... N90-29461 #
AD-A223412 ..... N90-29305 #
AD-A223414 ..... N90-29510 #
AD-A223418 ..... N90-29546 #
AD-A223419 ..... N90-29547 #
AD-A223431 ..... N90-29664 #
AD-A223432 ..... N90-29665 #
AD-A223433 ..... N90-29666 #
AD-A223437 ..... N90-29571 #
AD-A223439 ..... N90-29734 #
AD-A223445 ..... N90-29548 #
AD-A223446 ..... N90-29549 #
AD-A223448 ..... N90-29550 #
AD-A223450 ..... N90-29406 #
AD-A223451 ..... N90-29442 #
AD-A223452 ..... N90-30097 #
AD-A223457 ..... N90-30077 #
AD-A223472 ..... N90-30019 #
AD-A223476 ..... N90-29939* #
AD-A223477 ..... N90-29654 #
AD-A223479 ..... N90-29940 #
AD-A223487 ..... N90-29687 #
AD-A223488 ..... N90-29916 #
AD-A223491 ..... N90-29768 #
AD-A223494 ..... N90-30098 #
AD-A223500 ..... N90-30020 #
AD-A223502 ..... N90-29443 #
AD-A223516 ..... N90-29396 #
AD-A223517 ..... N90-29462 #

AD-A223531 ..... N90-29417 #
AD-A223532 ..... N90-29941 #
AD-A223544 ..... N90-30040 #
AD-A223549 ..... N90-29750 #
AD-A223550 ..... N90-29572 #
AD-A223551 ..... N90-29942 #
AD-A223552 ..... N90-30099 #
AD-A223556 ..... N90-29551 #
AD-A223557 ..... N90-30100 #
AD-A223558 ..... N90-30050 #
AD-A223560 ..... N90-29668 #
AD-A223561 ..... N90-29669 #
AD-A223562 ..... N90-29631 #
AD-A223564 ..... N90-29407 #
AD-A223565 ..... N90-30021 #
AD-A223567 ..... N90-29478 #
AD-A223568 ..... N90-29735 #
AD-A223572 ..... N90-30034 #
AD-A223575 ..... N90-29632 #
AD-A223578 ..... N90-29980 #
AD-A223582 ..... N90-29736 #
AD-A223595 ..... N90-30027 #
AD-A223600 ..... N90-29511 #
AD-A223601 ..... N90-29512 #
AD-A223609 ..... N90-29444 #
AD-A223610 ..... N90-29644 #
AD-A223611 ..... N90-29552 #
AD-A223612 ..... N90-29513 #
AD-A223613 ..... N90-30163 #
AD-A223619 ..... N90-29655 #
AD-A223624 ..... N90-30051 #
AD-A223626 ..... N90-29645 #
AD-A223633 ..... N90-29943 #
AD-A223634 ..... N90-29670 #
AD-A223635 ..... N90-29769 #
AD-A223640 ..... N90-30001 #
AD-A223641 ..... N90-29944 #
AD-A223643 ..... N90-30002 #
AD-A223647 ..... N90-29573 #
AD-A223660 ..... N90-29737 #
AD-A223673 ..... N90-29479 #
AD-A223676 ..... N90-29480 #
AD-A223678 ..... N90-29595 #
AD-A223681 ..... N90-29514 #
AD-A223683 ..... N90-30133 #
AD-A223685 ..... N90-29738 #
AD-A223687 ..... N90-30035 #
AD-A223688 ..... N90-29574 #
AD-A223691 ..... N90-29435 #
AD-A223694 ..... N90-29408 #
AD-A223696 ..... N90-29445 #
AD-A223698 ..... N90-30003 #
AD-A223699 ..... N90-29945 #
AD-A223700 ..... N90-29946 #
AD-A223701 ..... N90-29777* #
AD-A223709 ..... N90-29619 #
AD-A223724 ..... N90-29671 #
AD-A223728 ..... N90-30004 #
AD-A223729 ..... N90-29515 #
AD-A223731 ..... N90-29947 #
AD-A223732 ..... N90-29988 #
AD-A223738 ..... N90-29948 #
AD-A223741 ..... N90-30005 #
AD-A223742 ..... N90-30028 #
AD-A223743 ..... N90-29739 #
AD-A223748 ..... N90-30101 #
AD-A223754 ..... N90-29981 #
AD-A223758 ..... N90-29575 #
AD-A223760 ..... N90-29949 #
AD-A223761 ..... N90-29950 #
AD-A223762 ..... N90-29379 #
AD-A223770 ..... N90-30036 #
AD-A223771 ..... N90-29306 #
AD-A223772 ..... N90-29951 #
AD-A223776 ..... N90-29596 #
AD-A223783 ..... N90-29952 #
AD-A223784 ..... N90-29576 #
AD-A223793 ..... N90-29695 #
AD-A223794 ..... N90-30052 #
AD-A223796 ..... N90-29553 #
AD-A223801 ..... N90-29446 #
AD-A223811 ..... N90-29751 #
AD-A223812 ..... N90-29953 #

AD-A223815 ..... N90-29770 #
AD-A223818 ..... N90-29771 #
AD-A223830 ..... N90-30006 #
AD-A223840 ..... N90-29554 #
AD-A223852 ..... N90-29555 #
AD-A223853 ..... N90-29307 #
AD-A223854 ..... N90-29954 #
AD-A223855 ..... N90-30053 #
AD-A223898 ..... N90-29767 #
AD-A223903 ..... N90-29985 #
AD-A223908 ..... N90-29723 #
AD-A223915 ..... N90-29773 #
AD-A223921 ..... N90-29927 #
AD-A223925 ..... N90-29928 #
AD-A223928 ..... N90-29694 #
AD-A223945 ..... N90-29560 #
AD-A223946 ..... N90-30128 #
AD-A224035 ..... N90-29996 #
AD-A224065 ..... N90-29759 #
AD-A224067 ..... N90-29997 #
AD-A224068 ..... N90-29525 #
AD-A224069 ..... N90-30093 #
AD-A224070 ..... N90-29586 #
AD-A224074 ..... N90-29526 #
AD-A224076 ..... N90-30015 #
AD-A224091 ..... N90-30064 #
AD-A224094 ..... N90-30047 #
AD-A224105 ..... N90-29561 #
AD-A224118 ..... N90-30033 #
AD-A224126 ..... N90-29386 #
AD-A224152 ..... N90-30016 #
AD-A224155 ..... N90-30162 #
AD-A224161 ..... N90-29454 #
AD-A224164 ..... N90-29587 #
AD-A224167 ..... N90-30048 #
AD-A224168 ..... N90-29387 #
AD-A224172 ..... N90-29588 #
AD-A224176 ..... N90-29531 #
AD-A224207 ..... N90-29418 #
AD-A224213 ..... N90-29502 #
AD-A224219 ..... N90-29627 #
AD-A224227 ..... N90-29764 #
AD-A224236 ..... N90-29774 #
AD-A224237 ..... N90-29438 #
AD-A224238 ..... N90-29302 #
AD-A224239 ..... N90-29536 #
AD-A224242 ..... N90-29998 #
AD-A224246 ..... N90-29503 #
AD-A224248 ..... N90-29504 #
AD-A224249 ..... N90-29643 #
AD-A224250 ..... N90-29474 #
AD-A224253 ..... N90-29395 #
AD-A224256 ..... N90-29299 #
AD-A224264 ..... N90-29562 #
AD-A224267 ..... N90-29978 #
AD-A224268 ..... N90-29929 #
AD-A224271 ..... N90-29913 #
AD-A224272 ..... N90-29930 #
AD-A224273 ..... N90-29431 #
AD-A224274 ..... N90-29986 #
AD-A224276 ..... N90-29563 #
AD-A224281 ..... N90-29455 #
AD-A224282 ..... N90-30065 #
AD-A224284 ..... N90-29931 #
AD-A224285 ..... N90-29475 #
AD-A224287 ..... N90-29589 #
AD-A224307 ..... N90-30017 #
AD-A224317 ..... N90-30018 #
AD-A224324 ..... N90-29456 #
AD-A224325 ..... N90-30094 #
AD-A224327 ..... N90-29590 #
AD-A224328 ..... N90-29932 #
AD-A224335 ..... N90-29617 #
AD-A224336 ..... N90-29476 #
AD-A224343 ..... N90-30066 #
AD-A224344 ..... N90-29933 #
AD-A224346 ..... N90-30129 #
AD-A224349 ..... N90-29457 #
AD-A224354 ..... N90-29303 #
AD-A224358 ..... N90-29539 #
AD-A224379 ..... N90-29626 #
AD-A224382 ..... N90-29540 #
AD-A224387 ..... N90-29934 #

AD-A224391 ..... N90-29724 #
AD-A224392 ..... N90-29725 #
AD-A224393 ..... N90-29726 #
AD-A224395 ..... N90-30153 #
AD-A224397 ..... N90-29727 #
AD-A224398 ..... N90-29368 #
AD-A224399 ..... N90-29541 #
AD-A224400 ..... N90-29542 #
AD-A224401 ..... N90-29728 #
AD-A224402 ..... N90-29729 #
AD-A224404 ..... N90-29707 #
AD-A224411 ..... N90-29432 #
AD-A224431 ..... N90-30039 #
AD-A224433 ..... N90-29653 #
AD-A224441 ..... N90-29935 #
AD-A224443 ..... N90-29987 #
AD-A224446 ..... N90-29564 #
AD-A224452 ..... N90-30067 #
AD-A224460 ..... N90-29505 #
AD-A224462 ..... N90-29506 #
AD-A224472 ..... N90-29936 #
AD-A224476 ..... N90-29920 #
AD-A224477 ..... N90-29389* #
AD-A224486 ..... N90-29565 #
AD-A224490 ..... N90-30130 #
AD-A224502 ..... N90-29591 #
AD-A224504 ..... N90-29661 #
AD-A224509 ..... N90-29439 #
AD-A224510 ..... N90-29543 #
AD-A224523 ..... N90-29566 #
AD-A224533 ..... N90-29567 #
AD-A224539 ..... N90-30049 #
AD-A224551 ..... N90-29458 #
AD-A224560 ..... N90-29775 #
AD-A224568 ..... N90-29568 #
AD-A224568 ..... N90-30131 #
AD-A224569 ..... N90-29776 #
AD-A224576 ..... N90-29527 #

AD-D014594 ..... N90-29569
AD-D014595 ..... N90-29629 #
AD-D014596 ..... N90-29630 #

AD-E900936 ..... N90-29986 #
AD-E900939 ..... N90-29930 #
AD-E900951 ..... N90-29913 #
AD-E900966 ..... N90-29563 #
AD-E901001 ..... N90-29431 #

AECL-9570 ..... N90-29559 #
AECL-9728 ..... N90-29501 #

AEDC-TR-90-7 ..... N90-29395 #

AFATL-TP-90-08 ..... N90-29307 #

AFHRL-TP-90-6 ..... N90-29996 #

AFHRL-TR-90-20 ..... N90-29407 #

AFIT/CI/CIA-89-008 ..... N90-29779 #
AFIT/CI/CIA-90-61 ..... N90-29936 #
AFIT/CI/CIA-90-035 ..... N90-29389* #
AFIT/CI/CIA-90-046 ..... N90-29920 #

AFIT/GE/ENG/90J-01 ..... N90-29462 #
AFIT/GE/ENG/90J-03 ..... N90-29545 #

AFOSR-TR-90-0743 ..... N90-29695 #
AFOSR-TR-90-0833 ..... N90-29432 #

AFOSR-90-07TR ..... N90-29734 #
AFOSR-90-0570TR-PT-2 ..... N90-29445 #
AFOSR-90-0650TR ..... N90-30021 #
AFOSR-90-0662TR ..... N90-29932 #
AFOSR-90-0663TR ..... N90-29939* #
AFOSR-90-0671TR ..... N90-30051 #
AFOSR-90-0673TR ..... N90-30096 #
AFOSR-90-0674TR ..... N90-30064 #
AFOSR-90-0675TR ..... N90-29940 #
AFOSR-90-0676TR ..... N90-29595 #
AFOSR-90-0683TR ..... N90-29768 #
AFOSR-90-0685TR ..... N90-29590 #
AFOSR-90-0687TR ..... N90-29305 #
AFOSR-90-0698TR ..... N90-30019 #
AFOSR-90-0711TR ..... N90-29507 #
AFOSR-90-0718TR ..... N90-30101 #
AFOSR-90-0719TR ..... N90-29552 #
AFOSR-90-0732TR ..... N90-30001 #
AFOSR-90-0735TR ..... N90-29980 #
AFOSR-90-0744TR ..... N90-29931 #
AFOSR-90-0745TR ..... N90-29475 #
AFOSR-90-0747TR ..... N90-29386 #
AFOSR-90-0748TR ..... N90-29455 #
AFOSR-90-0755TR ..... N90-29764 #
AFOSR-90-0760TR ..... N90-29774 #

AFOSR-90-0761TR ..... N90-30065 #
AFOSR-90-0762TR ..... N90-29596 #
AFOSR-90-0765TR ..... N90-29439 #
AFOSR-90-0772TR ..... N90-29540 #
AFOSR-90-0776TR ..... N90-29628 #
AFOSR-90-0778TR ..... N90-29653 #
AFOSR-90-0779TR ..... N90-29775 #
AFOSR-90-0783TR ..... N90-29776 #
AFOSR-90-0804TR ..... N90-30039 #
AFOSR-90-0837TR ..... N90-29661 #
AFOSR-90-0838TR ..... N90-29458 #

AFWAL-TR-87-2042-VOL-13 ..... N90-29527 #

AGARD-AG-314 ..... N90-29338 #

AGARD-AR-245 ..... N90-29393 #
AGARD-AR-288 ..... N90-29404 #

AI-M-1152 ..... N90-29929 #
AI-M-1173 ..... N90-29945 #
AI-M-1189 ..... N90-29946 #
AI-M-1190 ..... N90-29985 #
AI-M-1215 ..... N90-30003 #
AI-M-1223 ..... N90-29671 #
AI-M-1225 ..... N90-29978 #

AL-TR-90-019 ..... N90-30066 #
AL-TR-90-033 ..... N90-29525 #

ANL-90/25 ..... N90-30109 #

ARCCB-TR-90014 ..... N90-29477 #

ARFSD-TR-90003 ..... N90-29643 #
ARFSD-TR-90004 ..... N90-29942 #

ARO-21470.11-GS ..... N90-29539 #
ARO-21654.9-PH ..... N90-29438 #
ARO-22063.15-CH-H ..... N90-29460 #
ARO-23699.27-MA ..... N90-30016 #
ARO-23777.1-MA-F ..... N90-29947 #
ARO-23981.2-CH ..... N90-29627 #
ARO-24373.20-MA-SDI ..... N90-30004 #
ARO-24407.5-GS ..... N90-29732 #
ARO-24626.146-PH-UIR ..... N90-30049 #
ARO-24820.8-EL ..... N90-29538 #
ARO-25045.39-EL ..... N90-29570 #
ARO-25229.21-CH ..... N90-29502 #
ARO-25575.7-EG ..... N90-29302 #
ARO-26171.3-MS-A ..... N90-29505 #
ARO-26401.4-MS ..... N90-29506 #
ARO-26430.2-PH-CF ..... N90-29457 #
ARO-27319.1-EL-SBI ..... N90-30097 #
ARO-27574.3-MA ..... N90-30018 #
ARO-27619.1-EG-CF ..... N90-29304 #

BBN-7212 ..... N90-30035 #

BC-ISR-90-001 ..... N90-30129 #

BNL-44836 ..... N90-29599 #
BNL-44939 ..... N90-29494 #
BNL-44963 ..... N90-30058 #

BR-9023185 ..... N90-29592 #
BR-9023199 ..... N90-30075 #
BR-9023200 ..... N90-30076 #
BR-9023202 ..... N90-29405 #

BRDEC-2496 ..... N90-29504 #

BRL-MR-3838 ..... N90-29589 #

BRL-TR-3118 ..... N90-29418 #
BRL-TR-3119 ..... N90-29303 #

BR113779 ..... N90-29429 #
BR113883 ..... N90-30062 #
BR113950 ..... N90-30115 #
BR113987 ..... N90-30166 #
BR114075 ..... N90-29636 #
BR114336 ..... N90-30012 #
BR114693 ..... N90-29597 #
BR114694 ..... N90-29646 #

CAA-PAPER-89019 ..... N90-29336

CBPF-NF-044/89 ..... N90-30038 #

CERL-TR-M-90/15 ..... N90-29531 #

CMTC-8945-PT-2 ..... N90-29445 #

CMU/SEI-CM-25 ..... N90-29949 #

CMU/SEI-89-TR-33 ..... N90-29950 #
CMU/SEI-89-TR-38 ..... N90-29379 #
CMU/SEI-90-TR-5 ..... N90-30005 #

CONF-890693-2 ..... N90-29961 #
CONF-900170-2 ..... N90-30084 #
CONF-900402-8 ..... N90-30155 #
CONF-900466-75 ..... N90-30105 #
CONF-900466-76 ..... N90-30102 #
CONF-900466-77 ..... N90-30108 #
CONF-900466-78 ..... N90-29520 #
CONF-900466-80 ..... N90-29490 #
CONF-900466-81 ..... N90-30111 #
CONF-900495-1 ..... N90-30155 #
CONF-900610-1 ..... N90-29672 #
CONF-900623-15 ..... N90-29496 #
CONF-900676-10 ..... N90-29708 #
CONF-900739-2 ..... N90-30086 #
CONF-900756-20 ..... N90-29577 #
CONF-900756-24 ..... N90-30054 #
CONF-900756-25 ..... N90-29957 #
CONF-900756-27 ..... N90-30055 #
CONF-900756-28 ..... N90-30056 #
CONF-900756-32 ..... N90-29620 #
CONF-900756-33 ..... N90-29621 #
CONF-900756-34 ..... N90-29530 #
CONF-900756-36 ..... N90-30057 #
CONF-900791-1 ..... N90-29656 #
CONF-900792-9 ..... N90-29635 #
CONF-900792-12 ..... N90-29529 #
CONF-900792-13 ..... N90-29534 #
CONF-900801-24 ..... N90-29308 #
CONF-900814-7 ..... N90-29674 #
CONF-900883-1 ..... N90-29494 #
CONF-900917-14 ..... N90-29599 #
CONF-901009-3 ..... N90-29519 #
CONF-901017-1-REV-1 ..... N90-30078 #
CONF-901017-2 ..... N90-30135 #
CONF-901017-3 ..... N90-29532 #
CONF-901034-1 ..... N90-29491 #
CONF-901055-1 ..... N90-29778 #
CONF-901071-1 ..... N90-29518 #
CONF-901071-2 ..... N90-29517 #
CONF-901071-3 ..... N90-29516 #
CONF-901071-5 ..... N90-29647 #
CONF-901071-7 ..... N90-29448 #
CONF-901074-1 ..... N90-30134 #
CONF-901088-1 ..... N90-29463 #
CONF-901089-1 ..... N90-29955 #
CONF-901095-1 ..... N90-29481 #
CONF-901095-5 ..... N90-29483 #
CONF-8806477 ..... N90-29914 #
CONF-8902182 ..... N90-29915 #
CONF-8904259-3 ..... N90-30058 #
CONF-8905112-4 ..... N90-29493 #
CONF-8907130-6 ..... N90-29634 #
CONF-8908134-31 ..... N90-29633 #
CONF-8909101-1 ..... N90-30085 #
CONF-8912106 ..... N90-30118 #
CONF-9002111-2 ..... N90-29712 #
CONF-9003189-1 ..... N90-30107 #
CONF-9003190-1 ..... N90-30106 #
CONF-9004209-6 ..... N90-30044 #
CONF-9005247-3 ..... N90-29495 #
CONF-9005248-4 ..... N90-30156 #
CONF-9006195-8 ..... N90-29989 #
CONF-9006221-3 ..... N90-30139 #
CONF-9006226-2 ..... N90-29578 #
CONF-9006252-1-REV-1 ..... N90-29533 #
CONF-9006255-1 ..... N90-30103 #
CONF-9006256-1 ..... N90-30147 #
CONF-9007138-2 ..... N90-30079 #
CONF-9007147-1 ..... N90-29521 #
CONF-9009201-1 ..... N90-29698 #
CONF-9009223-2 ..... N90-29523 #
CONF-9010120-1 ..... N90-29752 #
CONF-9010159-1 ..... N90-29482 #

CRDEC-CR-067 ..... N90-30050 #

CRDEC-TR-194 ..... N90-30048 #
CRDEC-TR-199 ..... N90-29454 #

CRR-90030 ..... N90-29567 #

CS-TR-265-90 ..... N90-29944 #
CS-TR-267-90 ..... N90-30002 #

D-377 ..... N90-29424* #

DC-119 ..... N90-29645 #

DERAT-RSF-50/5018-37 ..... N90-29600 #
DERAT-RSF-50/5018-38 ..... N90-29600 #

DE90-000343 ..... N90-29308 #

DE90-000360 ..... N90-29696 #
DE90-000363 ..... N90-29697 #
DE90-008944 ..... N90-29778 #
DE90-009706 ..... N90-29516 #
DE90-010068 ..... N90-29517 #
DE90-010091 ..... N90-29518 #
DE90-010823 ..... N90-30134 #
DE90-011023 ..... N90-29955 #
DE90-011024 ..... N90-29463 #
DE90-011085 ..... N90-29633 #
DE90-011483 ..... N90-30078 #
DE90-011651 ..... N90-29532 #
DE90-011711 ..... N90-30135 #
DE90-011761 ..... N90-30136 #
DE90-011910 ..... N90-29481 #
DE90-012166 ..... N90-29519 #
DE90-012401 ..... N90-29492 #
DE90-012682 ..... N90-29464 #
DE90-012943 ..... N90-29647 #
DE90-013152 ..... N90-29752 #
DE90-014580 ..... N90-29924 #
DE90-014672 ..... N90-29642 #
DE90-014678 ..... N90-29616 #
DE90-014679 ..... N90-29641 #
DE90-014770 ..... N90-29500 #
DE90-014835 ..... N90-30137 #
DE90-014836 ..... N90-30109 #
DE90-014850 ..... N90-29426 #
DE90-014851 ..... N90-29673 #
DE90-014866 ..... N90-29917 #
DE90-014871 ..... N90-29963 #
DE90-014873 ..... N90-29711 #
DE90-014894 ..... N90-29449 #
DE90-014915 ..... N90-30156 #
DE90-015124 ..... N90-29599 #
DE90-015131 ..... N90-29452 #
DE90-015176 ..... N90-29652 #
DE90-015188 ..... N90-29533 #
DE90-015189 ..... N90-29482 #
DE90-015190 ..... N90-29483 #
DE90-015194 ..... N90-29577 #
DE90-015195 ..... N90-30079 #
DE90-015198 ..... N90-30147 #
DE90-015202 ..... N90-29634 #
DE90-015203 ..... N90-29620 #
DE90-015205 ..... N90-30102 #
DE90-015220 ..... N90-29465 #
DE90-015293 ..... N90-29484 #
DE90-015294 ..... N90-29472 #
DE90-015295 ..... N90-29485 #
DE90-015299 ..... N90-30103 #
DE90-015301 ..... N90-30139 #
DE90-015314 ..... N90-29447 #
DE90-015317 ..... N90-29466 #
DE90-015352 ..... N90-29648 #
DE90-015396 ..... N90-29956 #
DE90-015403 ..... N90-30083 #
DE90-015406 ..... N90-29708 #
DE90-015408 ..... N90-29709 #
DE90-015427 ..... N90-30037 #
DE90-015529 ..... N90-29453 #
DE90-015552 ..... N90-30104 #
DE90-015564 ..... N90-30054 #
DE90-015567 ..... N90-29698 #
DE90-015597 ..... N90-29672 #
DE90-015610 ..... N90-29957 #
DE90-015614 ..... N90-29989 #
DE90-015615 ..... N90-29621 #
DE90-015616 ..... N90-30044 #
DE90-015619 ..... N90-30056 #
DE90-015620 ..... N90-30055 #
DE90-015623 ..... N90-29486 #
DE90-015629 ..... N90-29958 #
DE90-015630 ..... N90-30155 #
DE90-015632 ..... N90-30105 #
DE90-015634 ..... N90-30106 #
DE90-015635 ..... N90-30107 #
DE90-015637 ..... N90-30108 #
DE90-015645 ..... N90-29487 #
DE90-015652 ..... N90-29635 #
DE90-015655 ..... N90-29959 #
DE90-015658 ..... N90-30084 #
DE90-015660 ..... N90-30085 #
DE90-015700 ..... N90-29520 #
DE90-015702 ..... N90-29521 #
DE90-015710 ..... N90-29488 #
DE90-015711 ..... N90-29598 #
DE90-015732 ..... N90-30080 #
DE90-015741 ..... N90-29530 #
DE90-015745 ..... N90-29529 #
DE90-015746 ..... N90-29534 #
DE90-015767 ..... N90-30110 #
DE90-015771 ..... N90-30081 #
DE90-015790 ..... N90-29448 #
DE90-015797 ..... N90-29493 #
DE90-015801 ..... N90-29960 #
DE90-015802 ..... N90-29649 #
DE90-015814 ..... N90-29710 #
DE90-015825 ..... N90-30086 #
DE90-015826 ..... N90-29489 #
DE90-015852 ..... N90-30042 #
DE90-015875 ..... N90-30008 #
DE90-015985 ..... N90-29961 #
DE90-016020 ..... N90-29674 #
DE90-016026 ..... N90-29712 #
DE90-016031 ..... N90-29490 #
DE90-016039 ..... N90-29491 #
DE90-016044 ..... N90-29656 #
DE90-016098 ..... N90-30082 #
DE90-016117 ..... N90-29741 #
DE90-016118 ..... N90-30007 #
DE90-016123 ..... N90-30087 #
DE90-016127 ..... N90-29962 #
DE90-016128 ..... N90-29964 #
DE90-016196 ..... N90-29467 #
DE90-016208 ..... N90-29579 #
DE90-016209 ..... N90-29522 #
DE90-016218 ..... N90-29578 #
DE90-016283 ..... N90-29523 #
DE90-016308 ..... N90-30057 #
DE90-016311 ..... N90-30058 #
DE90-016323 ..... N90-29494 #
DE90-016344 ..... N90-29495 #
DE90-016360 ..... N90-29496 #
DE90-016477 ..... N90-30111 #
DE90-016626 ..... N90-29699 #
DE90-507990 ..... N90-30117 #
DE90-508027 ..... N90-29544 #
DE90-508031 ..... N90-30068 #
DE90-508071 ..... N90-30118 #
DE90-508076 ..... N90-30069 #
DE90-508077 ..... N90-30070 #
DE90-508078 ..... N90-30071 #
DE90-508079 ..... N90-30072 #
DE90-508080 ..... N90-30073 #
DE90-508085 ..... N90-30160 #
DE90-627150 ..... N90-29990 #
DE90-627151 ..... N90-29991 #
DE90-627152 ..... N90-29992 #
DE90-627159 ..... N90-29993 #
DE90-627160 ..... N90-29994 #
DE90-627162 ..... N90-29995 #
DE90-627168 ..... N90-30023 #
DE90-627169 ..... N90-30024 #
DE90-627182 ..... N90-30119 #
DE90-627190 ..... N90-29592 #
DE90-627206 ..... N90-30116 #
DE90-627219 ..... N90-30120 #
DE90-627315 ..... N90-30090 #
DE90-627316 ..... N90-30091 #
DE90-627318 ..... N90-29473 #
DE90-627325 ..... N90-30092 #
DE90-627479 ..... N90-30063 #
DE90-627482 ..... N90-30154 #
DE90-627522 ..... N90-30038 #
DE90-628369 ..... N90-29999 #
DE90-628370 ..... N90-30121 #
DE90-628377 ..... N90-30025 #
DE90-628755 ..... N90-30074 #
DE90-628904 ..... N90-30075 #
DE90-628905 ..... N90-30076 #
DE90-629716 ..... N90-29501 #
DE90-630400 ..... N90-29559 #
DE90-630463 ..... N90-29405 #
DE90-631277 ..... N90-29914 #
DE90-631408 ..... N90-29915 #
DE90-631545 ..... N90-29662 #

DFVLR-FB-89-52 ..... N90-29692 #

DIGEL-1990-1 ..... N90-29582 #

DLR-FB-89-38 ..... N90-29605 #
DLR-FB-90-03 ..... N90-29676 #
DLR-FB-90-07 ..... N90-29754 #
DLR-FB-90-10 ..... N90-29613 #
DLR-FB-90-12 ..... N90-29700 #
DLR-FB-90-14 ..... N90-29766 #

DLR-MITT-90-01 ..... N90-29624 #
DLR-MITT-90-02 ..... N90-29401 #
DLR-MITT-90-06 ..... N90-29967 #
DLR-MITT-90-07 ..... N90-29753 #

DNA-TR-89-262 ..... N90-29554 #

DODA-AR-005-982 ..... N90-29550 #
DODA-AR-006-401 ..... N90-29549 #

DOE-3 ..... N90-30087 #

DOE/AL-43058/T3 ..... N90-29464 #

DOE/BC-14200/T1 ..... N90-29487 #

DOE/DP-10782/1 ..... N90-30082 #

DOE/ER-0466P ..... N90-30137 #
DOE/ER-13463/7 ..... N90-29453 #
DOE/ER-13530/T1 ..... N90-29741 #
DOE/ER-13560/T1 ..... N90-29522 #
DOE/ER-13569/5 ..... N90-29489 #
DOE/ER-25006/4 ..... N90-29962 #
DOE/ER-25006/5 ..... N90-29964 #
DOE/ER-25013/5 ..... N90-29959 #
DOE/ER-25019/18 ..... N90-30007 #
DOE/ER-25026/36 ..... N90-30008 #
DOE/ER-40415/15 ..... N90-30042 #
DOE/ER-40531/1 ..... N90-30037 #
DOE/ER-45295/3 ..... N90-29492 #
DOE/ER-52127/67 ..... N90-30085 #
DOE/ER-52127/70 ..... N90-30084 #
DOE/ER-53243/3 ..... N90-30087 #
DOE/ER-53263/9 ..... N90-30080 #
DOE/ER-60932/1 ..... N90-29710 #

DOE/ET-15601/38 ..... N90-30053 #
DOE/ET-51013/283 ..... N90-30066 #

DOE/PC-80518/T13 ..... N90-29487 #
DOE/PC-90534/15 ..... N90-29485 #

DOT/FAA/AS-90/1 ..... N90-29408 #

DOT/FAA/CT-TN89/48 ..... N90-29937 #

DOT/FAA/EE-90-03 ..... N90-30035 #

DOT/FAA/RD-90/1 ..... N90-29299 #

DRIC-BR-113987 ..... N90-30162 #

DTRC-SME-89/100 ..... N90-30098 #

EGG-MS-8945 ..... N90-29478 #

EML-524 ..... N90-29711 #

EOARD-TR-90-06 ..... N90-30100 #

EPA/600/D-90/084 ..... N90-29706 #

ERIM-213400-54-F ..... N90-29406 #

ERL-0502-RN ..... N90-29550 #
ERL-0511-RE ..... N90-29549 #

ESA-BR-65 ..... N90-29427 #
ESA-BR-66 ..... N90-30168 #
ESA-BR-70 ..... N90-29428 #

ESA-SP-1124 ..... N90-30141 #
ESA-SP-1126 ..... N90-30142 #
ESA-SP-1133 ..... N90-29968 #
ESA-SP-1134 ..... N90-30157 #

ESA-TM-05 ..... N90-29419 #
ESA-TM-06 ..... N90-29969 #

ESA-TT-1204 ..... N90-29605 #
ESA-TT-1207 ..... N90-29692 #

ESD-TR-89-44 ..... N90-29950 #
ESD-TR-89-49 ..... N90-29379 #
ESD-TR-89-296 ..... N90-29547 #
ESD-TR-90-008 ..... N90-29546 #
ESD-TR-90-218 ..... N90-30005 #
ESD-TR-90-307 ..... N90-29938 #
ESD-TR-90-0191 ..... N90-29953 #

ETN-90-97106 ..... N90-29537 #
ETN-90-97285 ..... N90-30059 #
ETN-90-97286 ..... N90-29962 #
ETN-90-97294 ..... N90-30022 #
ETN-90-97296 ..... N90-30043 #
ETN-90-97298 ..... N90-30009 #
ETN-90-97301 ..... N90-29580 #
ETN-90-97303 ..... N90-30112 #
ETN-90-97307 ..... N90-29581 #
ETN-90-97310 ..... N90-30113 #
ETN-90-97312 ..... N90-29468 #
ETN-90-97313 ..... N90-30114 #
ETN-90-97320 ..... N90-29310 #
ETN-90-97321 ..... N90-30060 #
ETN-90-97323 ..... N90-29469 #
ETN-90-97364 ..... N90-29742
ETN-90-97400 ..... N90-29623
ETN-90-97407 ..... N90-29558
ETN-90-97412 ..... N90-29535

ETN-90-97413 ..... N90-29380
ETN-90-97414 ..... N90-29409
ETN-90-97415 ..... N90-29536
ETN-90-97513 ..... N90-29675 #
ETN-90-97517 ..... N90-29966 #
ETN-90-97533 ..... N90-29582 #
ETN-90-97534 ..... N90-30029 #
ETN-90-97536 ..... N90-29624 #
ETN-90-97537 ..... N90-29401 #
ETN-90-97540 ..... N90-29967 #
ETN-90-97541 ..... N90-29753 #
ETN-90-97542 ..... N90-29676 #
ETN-90-97545 ..... N90-29754 #
ETN-90-97546 ..... N90-29766 #
ETN-90-97556 ..... N90-29600 #
ETN-90-97557 ..... N90-29311 #
ETN-90-97558 ..... N90-29601 #
ETN-90-97559 ..... N90-29602 #
ETN-90-97560 ..... N90-29603 #
ETN-90-97561 ..... N90-29497 #
ETN-90-97562 ..... N90-29312 #
ETN-90-97563 ..... N90-29677 #
ETN-90-97564 ..... N90-29498 #
ETN-90-97565 ..... N90-29963 #
ETN-90-97566 ..... N90-29313 #
ETN-90-97567 ..... N90-30061 #
ETN-90-97585 ..... N90-29918 #
ETN-90-97586 ..... N90-29604 #
ETN-90-97588 ..... N90-30141 #
ETN-90-97589 ..... N90-30142 #
ETN-90-97590 ..... N90-29968 #
ETN-90-97591 ..... N90-30157 #
ETN-90-97592 ..... N90-29419 #
ETN-90-97593 ..... N90-29969 #
ETN-90-97594 ..... N90-29427 #
ETN-90-97595 ..... N90-30168 #
ETN-90-97596 ..... N90-29428 #
ETN-90-97597 ..... N90-29605 #
ETN-90-97598 ..... N90-29692 #
ETN-90-97599 ..... N90-30169 #
ETN-90-97600 ..... N90-30010 #
ETN-90-97601 ..... N90-30011 #
ETN-90-97602 ..... N90-29429 #
ETN-90-97603 ..... N90-30166 #
ETN-90-97604 ..... N90-30170 #
ETN-90-97606 ..... N90-29636 #
ETN-90-97607 ..... N90-30062 #
ETN-90-97608 ..... N90-30115 #
ETN-90-97610 ..... N90-30012 #
ETN-90-97611 ..... N90-29970
ETN-90-97612 ..... N90-29524
ETN-90-97613 ..... N90-29335
ETN-90-97614 ..... N90-29336
ETN-90-97615 ..... N90-29971
ETN-90-97616 ..... N90-29583
ETN-90-97617 ..... N90-29755 #
ETN-90-97618 ..... N90-29756
ETN-90-97619 ..... N90-29584
ETN-90-97620 ..... N90-29972
ETN-90-97621 ..... N90-29973
ETN-90-97622 ..... N90-29585
ETN-90-97623 ..... N90-29314 #
ETN-90-97624 ..... N90-29606 #
ETN-90-97625 ..... N90-29613 #
ETN-90-97627 ..... N90-29700 #
ETN-90-97632 ..... N90-30013 #
ETN-90-97633 ..... N90-29678 #
ETN-90-97634 ..... N90-29451 #
ETN-90-97635 ..... N90-29337 #
ETN-90-97636 ..... N90-29772 #
ETN-90-97637 ..... N90-29679 #
ETN-90-97638 ..... N90-29390 #
ETN-90-97639 ..... N90-29680 #
ETN-90-97640 ..... N90-29681 #
ETN-90-97641 ..... N90-29682 #
ETN-90-97642 ..... N90-29683 #
ETN-90-97643 ..... N90-29684 #
ETN-90-97644 ..... N90-29685 #
ETN-90-97645 ..... N90-29433 #
ETN-90-97650 ..... N90-29760
ETN-90-97652 ..... N90-29713

EUT-89-E-224 ..... N90-30124 #

FEL-89-A184 ..... N90-29535
FEL-89-A257-PT-1 ..... N90-29380
FEL-89-A280-PT-2 ..... N90-29409
FEL-89-A293 ..... N90-29536
FEL-89-B65 ..... N90-29558
FEL-1989-64 ..... N90-29623

FERMILAB-PUB-90/1-A ..... N90-29557* #
FERMILAB-PUB-90/157-A ..... N90-30041* #
FERMILAB-PUB-90/176-A ..... N90-29556* #
FERMILAB-PUB-90/178-A ..... N90-29740* #

FFA-TN-1990-18 ..... N90-29675 #

FFI-89/7016 ..... N90-29755 #

FOA-C-30555-3.2 ..... N90-29537 #

GIT/AER-90-1 ..... N90-29304 #

GI88-496 ..... N90-29741 #

GL-ERP-1049 ..... N90-29749 #
GL-ERP-1057 ..... N90-29707 #
GL-ERP-1059 ..... N90-29735 #

GL-TR-89-0117 ..... N90-30040 #
GL-TR-89-0264 ..... N90-29730 #
GL-TR-89-0267 ..... N90-29737 #
GL-TR-89-0268 ..... N90-30153 #
GL-TR-89-0293 ..... N90-29723 #
GL-TR-89-0326 ..... N90-29728 #
GL-TR-90-0005 ..... N90-29727 #
GL-TR-90-0006 ..... N90-29749 #
GL-TR-90-0026 ..... N90-30129 #
GL-TR-90-0044 ..... N90-29542 #
GL-TR-90-0047(1) ..... N90-29733 #
GL-TR-90-0056 ..... N90-29707 #
GL-TR-90-0060 ..... N90-29724 #
GL-TR-90-0067 ..... N90-29735 #
GL-TR-90-0078 ..... N90-29729 #
GL-TR-90-0084 ..... N90-29726 #
GL-TR-90-0093 ..... N90-29725 #
GL-TR-90-0104 ..... N90-29731 #
GL-TR-90-0141 ..... N90-30000 #

GPO-32-196 ..... N90-30138 #
GPO-33-588 ..... N90-29704 #

GRI-90/0120 ..... N90-29699 #
GRI-90/0127 ..... N90-29693 #

HEL-TM-7-90 ..... N90-30133 #
HEL-TM-8-90 ..... N90-30020 #

HSD-TR-90-005 ..... N90-30036 #

IAEA-TECDOC-538 ..... N90-29915 #
IAEA-TECDOC-544 ..... N90-29914 #

IC-89/164 ..... N90-30063 #
IC-89/190 ..... N90-30116 #
IC-89/317 ..... N90-30092 #
IC-89/342 ..... N90-29990 #
IC-89/395 ..... N90-29991 #
IC-89/396 ..... N90-29992 #
IC-89/400 ..... N90-30090 #
IC-89/401 ..... N90-30091 #
IC-89/417 ..... N90-29473 #
IC-89/428 ..... N90-29993 #
IC-89/432 ..... N90-29994 #
IC-90/10 ..... N90-29995 #
IC-90/18 ..... N90-30154 #
IC-90/22 ..... N90-30120 #
IC-90/23 ..... N90-30119 #
IC-90/34 ..... N90-30023 #
IC-90/35 ..... N90-30024 #

ICMA-90-151 ..... N90-29997 #

ICR-201-89-18 ..... N90-30160 #

IFIN-FT-347-1989 ..... N90-29999 #
IFIN-FT-351-1989 ..... N90-30121 #

IMET-TR-89-05 ..... N90-29748 #

IMFL-90/04 ..... N90-30061 #

INIS-BR-2057 ..... N90-30075 #
INIS-BR-2058 ..... N90-30076 #
INIS-BR-2060 ..... N90-29405 #

INIS-MF-12604 ..... N90-30074 #

INS-T-493 ..... N90-30118 #

INS-804 ..... N90-30117 #
INS-809 ..... N90-29544 #

ISBN-0-86039-406-9 ..... N90-29336
ISBN-0-904947-21-1 ..... N90-29403
ISBN-0-904947-25-4 ..... N90-29334 #
ISBN-87-7478-297-5 ..... N90-29756
ISBN-90-6144-224-9 ..... N90-30124 #
ISBN-92-835-0499-2 ..... N90-29393 #
ISBN-92-835-0566-2 ..... N90-29338 #
ISBN-92-835-0572-7 ..... N90-29404 #

ISBN-92-9092-013-0 ..... N90-29969 #
ISBN-92-9092-039-4 ..... N90-29427 #
ISBN-92-9092-043-2 ..... N90-30168 #
ISBN-92-9092-059-9 ..... N90-29428 #
ISBN-92-9092-076-9 ..... N90-30142 #
ISBN-92-9092-108-0 ..... N90-29968 #
ISBN-92-9092-112-9 ..... N90-30157 #
ISBN-951-22-0037-6 ..... N90-30046 #
ISBN-951-45-5111-7 ..... N90-29923 #

ISSN-0067-0367 ..... N90-29559 #
ISSN-0101-6113 ..... N90-29592 #
ISSN-0143-7305 ..... N90-29583
ISSN-0143-7305 ..... N90-29971
ISSN-0169-1651 ..... N90-29713
ISSN-0169-1708 ..... N90-29760
ISSN-0171-1342 ..... N90-29613 #
ISSN-0171-1342 ..... N90-29676 #
ISSN-0171-1342 ..... N90-29700 #
ISSN-0171-1342 ..... N90-29754 #
ISSN-0171-1342 ..... N90-29766 #
ISSN-0176-7739 ..... N90-29401 #
ISSN-0176-7739 ..... N90-29624 #
ISSN-0176-7739 ..... N90-29753 #
ISSN-0176-7739 ..... N90-29967 #
ISSN-0250-1589 ..... N90-29427 #
ISSN-0250-1589 ..... N90-29428 #
ISSN-0250-1589 ..... N90-30168 #
ISSN-0258-025X ..... N90-30169 #
ISSN-0347-3708 ..... N90-29537 #
ISSN-0377-8312 ..... N90-29314 #
ISSN-0377-8312 ..... N90-29606 #
ISSN-0379-6566 ..... N90-29968 #
ISSN-0379-6566 ..... N90-30141 #
ISSN-0389-4010 ..... N90-29326 #
ISSN-0389-4010 ..... N90-29327 #
ISSN-0389-4010 ..... N90-29328 #
ISSN-0389-4010 ..... N90-29329 #
ISSN-0389-4010 ..... N90-29330 #
ISSN-0389-4010 ..... N90-29331 #
ISSN-0389-4010 ..... N90-29332 #
ISSN-0389-4010 ..... N90-29397 #
ISSN-0389-4010 ..... N90-29398 #
ISSN-0389-4010 ..... N90-29402 #
ISSN-0389-4010 ..... N90-29410 #
ISSN-0389-4010 ..... N90-29411 #
ISSN-0389-4010 ..... N90-29412 #
ISSN-0389-4010 ..... N90-29420 #
ISSN-0389-4010 ..... N90-29434 #
ISSN-0389-4010 ..... N90-29499 #
ISSN-0389-4010 ..... N90-29614 #
ISSN-0389-4010 ..... N90-29625 #
ISSN-0389-4010 ..... N90-29626 #
ISSN-0389-4010 ..... N90-29650 #
ISSN-0389-4010 ..... N90-29651 #
ISSN-0389-4010 ..... N90-29657 #
ISSN-0389-4010 ..... N90-29686 #
ISSN-0389-4010 ..... N90-29687 #
ISSN-0452-2982 ..... N90-29333 #
ISSN-0452-2982 ..... N90-29391 #
ISSN-0452-2982 ..... N90-29399 #
ISSN-0452-2982 ..... N90-29422 #
ISSN-0452-2982 ..... N90-29436 #
ISSN-0452-2982 ..... N90-29974 #
ISSN-0452-2982 ..... N90-30030 #
ISSN-0802-2437 ..... N90-29755 #
ISSN-0951-6301 ..... N90-29335
ISSN-1013-7076 ..... N90-29419 #
ISSN-1013-7076 ..... N90-29969 #

ITOP-6-2-529 ..... N90-29541 #

IYAF-89-35 ..... N90-30025 #

JAERI-M-90-001 ..... N90-30068 #

JAIA-TR-90-1 ..... N90-29302 #

JPL-PUBL-87-7-VOL-4 ..... N90-29830* #
JPL-PUBL-89-7-VOL-3 ..... N90-29780* #
JPL-PUBL-89-7-VOL-5 ..... N90-29874* #

JPRS-UES-90-003 ..... N90-29689 #
JPRS-UES-90-004 ..... N90-29686 #

JPRS-ULS-90-004 ..... N90-29763 #
JPRS-ULS-90-007 ..... N90-29762 #

JTN-90-80119 ..... N90-29974 #
JTN-90-80152 ..... N90-29421 #
JTN-90-80167 ..... N90-29422 #
JTN-90-80188 ..... N90-29399 #
JTN-90-80189 ..... N90-29436 #
JTN-90-80190 ..... N90-30030 #
JTN-90-80191 ..... N90-29333 #
JTN-90-80192 ..... N90-29391 #

K/CSD/TM-94 ..... N90-29963 #

KCP-613-4326 ..... N90-29523 #

KEK-PREPRINT-89-151 ..... N90-30160 #

KNMI-TR-121 ..... N90-29760

KNMI-WR-90-01 ..... N90-29713

L-16701 ..... N90-30014* #

LA-UR-90-776 ..... N90-29778 #
LA-UR-90-2161 ..... N90-29752 #
LA-UR-90-2374 ..... N90-30156 #

LA-11732-M ..... N90-29958 #
LA-11908-MS ..... N90-29956 #

LBL-27025-REV ..... N90-29699 #
LBL-28366 ..... N90-29449 #
LBL-28965 ..... N90-29486 #
LBL-29034 ..... N90-30103 #
LBL-29036 ..... N90-30105 #
LBL-29101 ..... N90-30155 #
LBL-29118 ..... N90-29466 #
LBL-29174 ..... N90-30106 #
LBL-29175 ..... N90-30107 #
LBL-29214 ..... N90-29447 #
LBL-29215 ..... N90-30108 #

LINC-1990-1 ..... N90-30029 #

LNCC-048/88 ..... N90-29592 #

LR-587 ..... N90-30013 #
LR-611 ..... N90-29678 #
LR-621 ..... N90-29451 #
LR-622 ..... N90-29337 #
LR-625 ..... N90-29772 #
LR-626 ..... N90-29679 #
LR-627 ..... N90-29390 #
LR-628 ..... N90-29680 #
LR-629 ..... N90-29681 #
LR-630-PT-1-REV ..... N90-29682 #
LR-630-PT-2 ..... N90-29683 #
LR-631 ..... N90-29684 #
LR-633 ..... N90-29685 #
LR-634 ..... N90-29433 #

LRC-90-16 ..... N90-30080 #

MATHS-REPT-A-125 ..... N90-30010 #
MATHS-REPT-A-126 ..... N90-30011 #

MLM-3645(OP) ..... N90-29635 #
MLM-3647(OP) ..... N90-29530 #
MLM-3649(OP) ..... N90-29529 #
MLM-3650(OP) ..... N90-29534 #

MPL-U-24/90 ..... N90-29739 #

MRC-R-1220 ..... N90-29554 #

MRC/ABQ-R-1281 ..... N90-30067 #

MRL-TR-90-5 ..... N90-30026 #

MSD-TR-90-10 ..... N90-29954 #

MTL-TR-90-27 ..... N90-29663 #

MTR-10226 ..... N90-29938 #

NADC-89100-60031 ..... N90-29443 #
NADC-90011-60 ..... N90-29442 #

NAL-TM-586 ..... N90-29974 #
NAL-TM-597-PT-3 ..... N90-29422 #
NAL-TM-600 ..... N90-29399 #
NAL-TM-601 ..... N90-29436 #
NAL-TM-603 ..... N90-30030 #
NAL-TM-604-2 ..... N90-29333 #
NAL-TM-607 ..... N90-29391 #

NAL-TR-1014 ..... N90-29402 #
NAL-TR-1018T ..... N90-29332 #
NAL-TR-1019 ..... N90-29651 #
NAL-TR-1020 ..... N90-29650 #
NAL-TR-1024 ..... N90-29625 #
NAL-TR-1025 ..... N90-29331 #
NAL-TR-1028 ..... N90-29330 #
NAL-TR-1032 ..... N90-29420 #
NAL-TR-1033 ..... N90-29687 #
NAL-TR-1034 ..... N90-29412 #
NAL-TR-1035 ..... N90-29329 #
NAL-TR-1037 ..... N90-29411 #
NAL-TR-1038T ..... N90-29328 #
NAL-TR-1039 ..... N90-29499 #
NAL-TR-1040 ..... N90-29657 #
NAL-TR-1041 ..... N90-29398 #
NAL-TR-1042 ..... N90-29397 #
NAL-TR-1043 ..... N90-29626 #
NAL-TR-1044 ..... N90-29434 #
NAL-TR-1045 ..... N90-29327 #
NAL-TR-1046 ..... N90-29326 #
NAL-TR-1047 ..... N90-29686 #
NAL-TR-1048 ..... N90-29410 #
NAL-TR-1049 ..... N90-29614 #

NAMRL-1352 ..... N90-29767 #

NAS 1.15:4208 ..... N90-30014* #
NAS 1.15:89637 ..... N90-30167* #
NAS 1.15:89680 ..... N90-30140* #
NAS 1.15:89695 ..... N90-30148* #
NAS 1.15:101167 ..... N90-29939* #
NAS 1.15:101232 ..... N90-30132* #
NAS 1.15:101822 ..... N90-29690* #
NAS 1.15:101823 ..... N90-29714* #
NAS 1.15:101867 ..... N90-30149* #
NAS 1.15:101880 ..... N90-30123* #
NAS 1.15:101908 ..... N90-29413* #
NAS 1.15:101909 ..... N90-29414* #
NAS 1.15:101910 ..... N90-29415* #
NAS 1.15:101913 ..... N90-29416* #
NAS 1.15:102699 ..... N90-29450* #
NAS 1.15:102716 ..... N90-29965* #
NAS 1.26:4304 ..... N90-29919* #
NAS 1.26:4312 ..... N90-29615* #
NAS 1.26:4324 ..... N90-29423* #
NAS 1.26:4325 ..... N90-29424* #
NAS 1.26:4326 ..... N90-29383* #
NAS 1.26:4328 ..... N90-29384* #
NAS 1.26:182090 ..... N90-29309* #
NAS 1.26:182094 ..... N90-30045* #
NAS 1.26:183046 ..... N90-29977* #
NAS 1.26:183355 ..... N90-29761* #
NAS 1.26:183853 ..... N90-30143* #
NAS 1.26:185210 ..... N90-29622* #
NAS 1.26:185277 ..... N90-29394* #
NAS 1.26:185599 ..... N90-29430* #
NAS 1.26:185931 ..... N90-29385* #
NAS 1.26:186223 ..... N90-30158* #
NAS 1.26:186226 ..... N90-29381* #
NAS 1.26:186275 ..... N90-29922* #
NAS 1.26:186314 ..... N90-29637* #
NAS 1.26:186335 ..... N90-29300* #
NAS 1.26:186346 ..... N90-29975* #
NAS 1.26:186370 ..... N90-29976* #
NAS 1.26:186469 ..... N90-29740* #
NAS 1.26:186506 ..... N90-29470* #
NAS 1.26:186858 ..... N90-29780* #
NAS 1.26:186859 ..... N90-29830* #
NAS 1.26:186860 ..... N90-29874* #
NAS 1.26:186993 ..... N90-29984* #
NAS 1.26:187031 ..... N90-29925* #
NAS 1.26:187265 ..... N90-29425* #
NAS 1.26:187270 ..... N90-29557* #
NAS 1.26:187271 ..... N90-30041* #
NAS 1.26:187272 ..... N90-29556* #
NAS 1.26:187289 ..... N90-29389* #
NAS 1.26:187290 ..... N90-29777* #

NASA-CR-4304 ..... N90-29919* #
NASA-CR-4312 ..... N90-29615* #
NASA-CR-4324 ..... N90-29423* #
NASA-CR-4325 ..... N90-29424* #
NASA-CR-4326 ..... N90-29383* #
NASA-CR-4328 ..... N90-29384* #
NASA-CR-182090 ..... N90-29309* #
NASA-CR-182094 ..... N90-30045* #
NASA-CR-183046 ..... N90-29977* #
NASA-CR-183355 ..... N90-29761* #
NASA-CR-183853 ..... N90-30143* #
NASA-CR-185210 ..... N90-29622* #
NASA-CR-185277 ..... N90-29394* #
NASA-CR-185599 ..... N90-29430* #
NASA-CR-185931 ..... N90-29385* #
NASA-CR-186223 ..... N90-30158* #
NASA-CR-186226 ..... N90-29381* #
NASA-CR-186275 ..... N90-29922* #
NASA-CR-186314 ..... N90-29637* #
NASA-CR-186335 ..... N90-29300* #
NASA-CR-186346 ..... N90-29975* #
NASA-CR-186370 ..... N90-29976* #
NASA-CR-186469 ..... N90-29740* #
NASA-CR-186506 ..... N90-29470* #
NASA-CR-186858 ..... N90-29780* #
NASA-CR-186859 ..... N90-29830* #
NASA-CR-186860 ..... N90-29874* #
NASA-CR-186993 ..... N90-29984* #
NASA-CR-187031 ..... N90-29925* #
NASA-CR-187265 ..... N90-29425* #
NASA-CR-187270 ..... N90-29557* #
NASA-CR-187271 ..... N90-30041* #
NASA-CR-187272 ..... N90-29556* #
NASA-CR-187289 ..... N90-29389* #
NASA-CR-187290 ..... N90-29777* #

NASA-TM-4208 ..... N90-30014* #
NASA-TM-89637 ..... N90-30167* #
NASA-TM-89680 ..... N90-30140* #
NASA-TM-89695 ..... N90-30148* #
NASA-TM-101167 ..... N90-29939* #
NASA-TM-101232 ..... N90-30132* #
NASA-TM-101822 ..... N90-29690* #
NASA-TM-101823 ..... N90-29714* #
NASA-TM-101867 ..... N90-30149* #
NASA-TM-101880 ..... N90-30123* #
NASA-TM-101908 ..... N90-29413* #
NASA-TM-101909 ..... N90-29414* #
NASA-TM-101910 ..... N90-29415* #
NASA-TM-101913 ..... N90-29416* #
NASA-TM-102699 ..... N90-29450* #
NASA-TM-102716 ..... N90-29965* #

NASDA-TR-22 ..... N90-29421 #

NCEER-90-0004 ..... N90-29722 #

NCSC-TM-492-88 ..... N90-29644 #

NHRC-89-47 ..... N90-29773 #
NHRC-89-49 ..... N90-29770 #
NHRC-89-53 ..... N90-29771 #

NIFS-5 ..... N90-30069 #
NIFS-6 ..... N90-30070 #
NIFS-7 ..... N90-30071 #
NIFS-8 ..... N90-30072 #
NIFS-9 ..... N90-30073 #

NIST/TN-1277 ..... N90-29638 #

NISTIR-90/4247 ..... N90-30127 #
NISTIR-90/4289 ..... N90-29471 #
NISTIR-4357 ..... N90-29984* #
NISTIR-4364 ..... N90-30089 #

NOAA-TM-ERL-ARL-183 ..... N90-29747 #

NOAA-TM-ERL-CMDL-1 ..... N90-29701 #

NORDA-238 ..... N90-29941 #

NOSC/TD-1772 ..... N90-29551 #
NOSC/TD-1776 ..... N90-30052 #
NOSC/TD-1809 ..... N90-29553 #
NOSC/TD-1848-VOL-1 ..... N90-29543 #

NOSC/TR-1345 ..... N90-29417 #

NPL-DES-86 ..... N90-29971
NPL-DES-89 ..... N90-29583

NPRDC-TN-90-23 ..... N90-29777* #

NPS53-90-006 ..... N90-30015 #
NPS62-90-007 ..... N90-29564 #

NRL-MR-6648 ..... N90-29750 #
NRL-MR-6651-PT-1 ..... N90-29508 #
NRL-MR-6661 ..... N90-29572 #
NRL-MR-6667 ..... N90-29587 #
NRL-MR-6674 ..... N90-30099 #
NRL-MR-6685 ..... N90-29588 #

NRL-9259 ..... N90-29979 #

NSSDC-90-07 ..... N90-30167* #

NSSDC/WDC-A-R/S-86-01-VOL-3B ..... N90-30140* #
NSSDC/WDC-A-R/S-87-03-VOL-1B ..... N90-30148* #
NSSDC/WDC-A-R/S-88-07-VOL-1A ..... N90-29415* #
NSSDC/WDC-A-R/S-88-10 ..... N90-29690* #
NSSDC/WDC-A-R/S-88-11-VOL-2B ..... N90-29414* #
NSSDC/WDC-A-R/S-88-12-VOL-5A/B ..... N90-29413* #
NSSDC/WDC-A-R/S-89-03 ..... N90-29714* #
NSSDC/WDC-A-R/S-89-10-VOL-4B ..... N90-30123* #
NSSDC/WDC-A-R/S-89-17-SUPPL-4 ..... N90-30149* #
NSSDC/WDC-A-R/S-89-25-VOL-6 ..... N90-29416* #

NUSC-TR-8295 ..... N90-29586 #
NUSC-TR-8315 ..... N90-29655 #
NUSC-TR-8315A ..... N90-29655 #

NWC-TP-7004 ..... N90-29930 #

NWC-TP-7027 ..... N90-29913 #
NWC-TP-7030 ..... N90-29986 #
NWC-TP-7066 ..... N90-29563 #
NWC-TP-7074 ..... N90-29431 #

NWRA-CR-89-R0147 ..... N90-29730 #
NWRA-CR-90-R060 ..... N90-29725 #

ONERA-RF-56/7131-PY ..... N90-29312 #

ONERA-RSF-87/7078/AY-100-A ..... N90-29313 #

ONERA-RT-4/1855-M ..... N90-29497 #
ONERA-RT-15/3578-M ..... N90-29496 #
ONERA-RT-77/1765-RY-089-R ..... N90-29677 #

ONERA-RTS-1/3717-CY ..... N90-29983 #

ORNL/ATD-39 ..... N90-29579 #

ORNL/FTR-3690 ..... N90-29649 #
ORNL/FTR-3698 ..... N90-30110 #
ORNL/FTR-3700 ..... N90-29960 #

ORNL/SUB-84-00221/1 ..... N90-29500 #
ORNL/SUB-86-55936/01 ..... N90-29596 #
ORNL/SUB-86-95900/02 ..... N90-29488 #

OULNS-89-11 ..... N90-30160 #

PAPER-ME-4-1-4 ..... N90-30165 #

PAPER-S-14-3-7 ..... N90-30164 #

PATENTS-US-A7308074 ..... N90-29642 #
PATENTS-US-A7310556 ..... N90-29616 #
PATENTS-US-A7311781 ..... N90-29641 #
PATENTS-US-A7350675 ..... N90-29924 #
PATENTS-US-A7375442 ..... N90-29452 #
PATENTS-US-A7379832 ..... N90-29652 #
PATENTS-US-A7385519 ..... N90-29648 #

PB90-189127 ..... N90-30046 #
PB90-190943 ..... N90-29923 #
PB90-191446 ..... N90-30124 #
PB90-197948 ..... N90-30127 #
PB90-207796 ..... N90-29471 #
PB90-208588 ..... N90-29701 #
PB90-214610 ..... N90-29705 #
PB90-220286 ..... N90-29638 #
PB90-230095 ..... N90-29691 #
PB90-242116 ..... N90-29748 #
PB90-244385 ..... N90-29693 #
PB90-244401 ..... N90-30089 #
PB90-244419 ..... N90-29984* #
PB90-244781 ..... N90-29758 #
PB90-246265 ..... N90-29706 #
PB90-251984 ..... N90-29722 #
PB90-252032 ..... N90-29747 #

PD-PR-8910 ..... N90-29926 #

PFC/CP-90-1 ..... N90-30086 #

PML-1990-C50 ..... N90-29433 #

PNL-SA-17145 ..... N90-29485 #
PNL-SA-17175 ..... N90-29472 #
PNL-SA-17529 ..... N90-29484 #
PNL-SA-17577 ..... N90-30104 #
PNL-SA-17804 ..... N90-29496 #
PNL-SA-17857 ..... N90-30139 #
PNL-SA-17896 ..... N90-29495 #
PNL-SA-18152 ..... N90-30057 #

PSU-CSSL-FR-90/1 ..... N90-29736 #

PSU/ARL/TR-90-009 ..... N90-30034 #
PSU/ARL/TR-90-010 ..... N90-30131 #

R/D-6329-AN-01 ..... N90-29528 #
R/D-6323-EN-01 ..... N90-29751 #
R/D-6332-CH-03 ..... N90-29575 #
R/D-6379-MS-02 ..... N90-29476 #

RADC-TR-90-25 ..... N90-29988 #
RADC-TR-90-53-VOL-2 ..... N90-29943 #
RADC-TR-90-69 ..... N90-29618 #
RADC-TR-90-72 ..... N90-29573 #
RADC-TR-90-87 ..... N90-29574 #
RADC-TR-90-90 ..... N90-30130 #
RADC-TR-90-93 ..... N90-29562 #
RADC-TR-90-168 ..... N90-29571 #

RAE-SPACE-673 ..... N90-29429 #
RAE-SPACE-677 ..... N90-30166 #

RAE-TR-88068 ..... N90-29429 #
RAE-TR-89048 ..... N90-30162 #
RAE-TR-89048 ..... N90-30166 #

RAE-TRANS-2176 ..... N90-29597 #
RAE-TRANS-2180 ..... N90-29646 #

REPT-NT-89-CC-18 ..... N90-29604 #

REPT-19 ..... N90-29471 #
REPT-53 ..... N90-30046 #
REPT-89-019 ..... N90-29584
REPT-89-041 ..... N90-29972
REPT-89-069 ..... N90-29973
REPT-90-003 ..... N90-29742
REPT-90-020 ..... N90-29585
REPT-7227 ..... N90-30036 #
REPT-1536920 ..... N90-30051 #

RI/RD-90-177 ..... N90-29622* #

RSRE-MEMO-4348 ..... N90-29636 #
RSRE-MEMO-4363 ..... N90-30062 #
RSRE-MEMO-4369 ..... N90-30115 #
RSRE-MEMO-4392 ..... N90-30012 #

S-HRG-101-842 ..... N90-29704 #

SAF/AQT-SR-90-009 ..... N90-30132* #

SAND-88-3158-REV ..... N90-29426 #
SAND-89-1810 ..... N90-30136 #
SAND-89-3009C ..... N90-30054 #
SAND-90-0091C ..... N90-29463 #
SAND-90-0109C ..... N90-29521 #
SAND-90-0645 ..... N90-29673 #
SAND-90-0985C ..... N90-30134 #
SAND-90-1335C ..... N90-29481 #
SAND-90-1383C ..... N90-29955 #
SAND-90-1639C ..... N90-29520 #
SAND-90-1955 ..... N90-29917 #
SAND-90-1963C ..... N90-29578 #
SAND-90-2130C ..... N90-29698 #

SC5459.FR ..... N90-29475 #

SERI/TP-211-3904 ..... N90-29696 #
SERI/TP-211-3914 ..... N90-29697 #
SERI/TP-254-3799 ..... N90-29308 #

SFCC-59 ..... N90-29433 #

SIO-REF-90-20 ..... N90-29739 #

SMU/DS/TR-239 ..... N90-30000 #

SR-1 ..... N90-29729 #
SR-1 ..... N90-29731 #
SR-1 ..... N90-29737 #
SR-2 ..... N90-29542 #
SR-2 ..... N90-30153 #

SRL-08-F-1990 ..... N90-29561 #

SSI-TR-171 ..... N90-29542 #

SU-GL-4694 ..... N90-30095 #

SYRU/DECE/TR-89/3 ..... N90-29568 #

TD-89-2325 ..... N90-29623
TD-89-3566 ..... N90-29535
TD-89-3568 ..... N90-29558
TD-89-3865-PT-2 ..... N90-29409
TD-89-3874-PT-1 ..... N90-29380
TD-89-4445 ..... N90-29536

TOP-6-3-037 ..... N90-29555 #

TR-LAC90-R23 ..... N90-29925* #

TR-4 ..... N90-30094 #
TR-5 ..... N90-29456 #
TR-5 ..... N90-29512 #
TR-6 ..... N90-29511 #
TR-10 ..... N90-29509 #
TR-10 ..... N90-29513 #
TR-14 ..... N90-29435 #
TR-15 ..... N90-29461 #
TR-18 ..... N90-29510 #
TR-36 ..... N90-29444 #
TR-90-1 ..... N90-29775 #
TR-90-3 ..... N90-29654 #
TR-90-05 ..... N90-30007 #
TR-90-25C ..... N90-30006 #
TR-105 ..... N90-30017 #

TR-113 ..... N90-30018 #
TR-286 ..... N90-30021 #
TR-292 ..... N90-30019 #
TR-298 ..... N90-30039 #
TR-429 ..... N90-30027 #
TR-878 ..... N90-29547 #
TR-880 ..... N90-29546 #
TR-886 ..... N90-29953 #

TT-9007 ..... N90-29403
TT-9010 ..... N90-29334 #

UAH-812 ..... N90-29430* #

UCLA-ENG-6762N-87 ..... N90-29595 #

UCRL-CR-104449 ..... N90-30081 #
UCRL-CR-104490 ..... N90-29709 #

UCRL-JC-102585 ..... N90-29577 #
UCRL-JC-103410 ..... N90-29708 #
UCRL-JC-104189 ..... N90-29482 #
UCRL-JC-104190 ..... N90-29483 #
UCRL-JC-104337 ..... N90-30056 #
UCRL-JC-104339 ..... N90-30055 #
UCRL-JC-104455 ..... N90-29621 #
UCRL-JC-104456 ..... N90-29620 #
UCRL-JC-104478 ..... N90-29957 #
UCRL-JC-104603 ..... N90-30044 #
UCRL-JC-104606 ..... N90-30079 #
UCRL-JC-104630 ..... N90-29989 #

UCRL-101555 ..... N90-29634 #
UCRL-101945-REV-1 ..... N90-30078 #
UCRL-102335 ..... N90-30102 #
UCRL-102337 ..... N90-30111 #
UCRL-102845-REV-1 ..... N90-29533 #
UCRL-102955 ..... N90-30147 #

UDR-TR-89-18 ..... N90-29667 #
UDR-TR-89-60 ..... N90-29396 #

UDR-716736-1 ..... N90-29618 #

UILU-ENG-89-1755 ..... N90-29987 #
UILU-ENG-90-1724 ..... N90-29935 #
UILU-ENG-90-2220 ..... N90-29645 #

UIUCDCS-R-89-1536 ..... N90-29987 #
UIUCDCS-R-90-1585 ..... N90-29935 #

ULRF-455/CAR ..... N90-29727 #
ULRF-456/CAR ..... N90-29729 #

UPR-0178E ..... N90-30160 #

US-PATENT-APPL-SN-308074 ..... N90-29642 #
US-PATENT-APPL-SN-310556 ..... N90-29616 #
US-PATENT-APPL-SN-311781 ..... N90-29641 #
US-PATENT-APPL-SN-350675 ..... N90-29924 #
US-PATENT-APPL-SN-375442 ..... N90-29452 #
US-PATENT-APPL-SN-379832 ..... N90-29652 #
US-PATENT-APPL-SN-385519 ..... N90-29648 #
US-PATENT-APPL-SN-520229 ..... N90-29630 #
US-PATENT-APPL-SN-531422 ..... N90-29629 #
US-PATENT-APPL-SN-535612 ..... N90-29569

USAARL-90-11 ..... N90-29916 #

USACSTA-6962 ..... N90-29654 #

USAF-STINFO-90/5 ..... N90-30132* #

USAFSAM-TR-89-27 ..... N90-29765 #

USGS-PP-1386-H-1 ..... N90-29691 #

UT-HE-90/07 ..... N90-30165 #
UT-HE-90/08 ..... N90-30164 #

UTRC-R90-917886-1 ..... N90-29446 #

UWAERP-21 ..... N90-30087 #

VKI-LS-1990-05 ..... N90-29314 #
VKI-LS-1990-06 ..... N90-29606 #

VTT-TUTK-658 ..... N90-29662 #

WES/TR/ITL-90-3-VOL-A ..... N90-29934 #

WHOI-89-30 ..... N90-29758 #
WHOI-89-49 ..... N90-29748 #

WL-TR-90-29 ..... N90-30067 #

WRDC-TR-89-1040 ..... N90-29585 #
WRDC-TR-89-2125 ..... N90-29667 #
WRDC-TR-89-2126 ..... N90-29396 #
WRDC-TR-89-3116-VOL-1 ..... N90-29664 #
WRDC-TR-89-3116-VOL-2 ..... N90-29665 #
WRDC-TR-89-3116-VOL-3 ..... N90-29666 #
WRDC-TR-89-4148 ..... N90-29387 #
WRDC-TR-90-1063 ..... N90-29952 #

Appendix—About STAR

Scientific and Technical Aerospace Reports (STAR) is a major component of a comprehensive National Aeronautics and Space Administration information system covering aeronautics, space, and supporting disciplines. *STAR* is issued on the 8th and 23rd of each month and announces current publications of the following types:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institutions, universities, and private firms
- Translations in report form
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

Journal, book, and conference literature, cover-to-cover journal translations, and certain foreign dissertations are announced in a companion journal, *International Aerospace Abstracts (IAA),* available on subscription from the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, NY 10019.

SUBJECT SCOPE

The subject scope of *STAR* and *IAA* includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

OTHER NASA PUBLICATIONS

Other NASA publications and information services are described in the publication, *The NASA Scientific and Technical Information System ... and How to Use It,* available without charge from the NASA Scientific and Technical Information Facility, P.O. Box 8757, BWI Airport, MD 21240.

HOW TO USE *STAR* SUBJECT CATEGORIES

STAR is categorized by 10 major subject divisions broken down further into 76 specific subject categories and one general division/category. The major subject divisions are listed on page ii in the Table of Contents, together with a note for each that defines its scope and provides any cross-references. For example:

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

Each major division is further divided into as many as nine specific categories, which are identified by category numbers.

Abstracts in *STAR* are grouped by subject category, the categories appearing in sequential order. Category breaks in the abstract section are identified by the category number and title, and a scope note. Cross-references to other categories are provided as appropriate. For example:

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

CROSS-REFERENCES

Individual *STAR* abstracts are not ordinarily cross-referenced, except for certain conference reports or book translations that have had separate abstracts written for their component papers or chapters. Citations and abstracts of the components follow immediately after those of the parent document. When the subject content of a component differs sufficiently from the general content of the parent, a cross-reference citation also is printed at the end of the category to which it normally would have been assigned if it were independent.

DOCUMENTS ON MICROFICHE

Documents on microfiche[1] are designated by a pound sign (#) following the accession number. The pound sign is used without regard to the source or quality of the microfiche.

LIMITED REPRODUCIBILITY

A Note of Limited Reproducibility appears in the citation, if one or a combination of the following factors affect the reproducibility of more than 20% of the document. These factors include: faint or broken type, color photographs, black and white photographs, foldouts, dot matrix print, charts/graphs with script notation, non-Roman alphabet, or some other factor that limits the reproducibility of that document. This notation also appears on the microfiche header, with the specific causing factor checked off on a list visible in the second frame.

COLOR COPIES

An increasing number of NASA scientific and technical reports are being produced with color graphs, charts, illustrations, and photographs. A message indicating that a document has color pages follows the Sales and Pricing (SAP) information in the *STAR* citation.

Registered users of the NASA Scientific and Technical Information System will receive ordered documents with color at no *additional* cost, as long as stock copies of that document are available. Otherwise, an additional fee of $2.00 per color page, over and above the standard document price will be charged. The NASA STI Facility staff will work with registered users over the telephone to inform and meet each individual's ordering needs.

AVAILABILITIES

One or more sources from which a document announced in *STAR* is available to the public is given in each citation. The most commonly indicated sources and their acronyms or abbreviations are listed below. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code following the letters HC or MF in the *STAR* citation. Current values for the price codes are given in the tables on page A-7.

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size, containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26:1 reduction).

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, VA 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the * symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report number* shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as indicated above, for those documents identified by a # symbol.)

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, address inquiry to the BLL.)

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts*. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center - Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: ESDU. Pricing information on specific data, computer programs, and details on Engineering Sciences Data Unit (ESDU) topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on page A-6.

Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, CA. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, DC 20546, or public document rooms located at NASA installations, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of

$1.50 each, postage free. (See discussion of NASA patents and patent applications below.)

Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INIS) representative in their country, or by applying directly to the issuing organization.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this Introduction. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

NASA PATENTS AND PATENT APPLICATIONS

Patents and patent applications owned by NASA are announced in *STAR* under appropriate subject categories and are referenced in the *STAR* indexes. In the Report/Accession Number Index, patents are indexed by the NASA Case Number (which appears in lieu of the report number in other indexes), the U.S. Patent Number, the U.S. Patent Application Serial Number, and the U.S. Patent Class. Patent applications for which patents have not yet been issued are indexed by the NASA Case Number and the U.S. Patent Application Serial Number.

NASA *patent application specifications* are sold in paper copy and microfiche by the National Technical Information Service (NTIS). The US-Patent-Appl-SN- number should be used in ordering either paper copy or microfiche from NTIS. Printed copies of *patents* (which are not microfiched) are available for purchase from:

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, DC 20231

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, by money order or check payable to the Commissioner of Patents and Trademarks. Prepaid purchase coupons for ordering are also available from the Patent and Trademark Office. The patents and patent applications announced in *STAR* are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

Associate General Counsel for Intellectual Property/Code GP
National Aeronautics and Space Administration
Washington, DC 20546

ELIGIBILITY AND REGISTRATION FOR NASA INFORMATION PRODUCTS AND SERVICES

A variety of services is available to organizations of the following types that have registered with NASA to receive specific services or products:

1. NASA offices and installations, contractors, subcontractors, grantees, and consultants;
2. Other U.S. Government agencies and their contractors;
3. Libraries in the United States that have arrangements with NASA to maintain collections of NASA documents for public reference;
4. Other organizations in the United States having a need for NASA documents in work related to aeronautics and space research;
5. Organizations abroad that have established reciprocal document exchange arrangements with NASA.

Only the central service points or central points of document acquisition and control within qualified organizations are eligible to register for NASA products and services. Domestic organizations that may be eligible to receive various classes of NASA publications and services should address their requests for registration or for further information to:

NASA Scientific and Technical Information Facility
ATTN: Registration Services
P.O. Box 8757
BWI Airport, MD 21240
301-621-0153

Organizations abroad should direct requests to Manager, International STI Activities, NTT, NASA Headquarters, Washington, DC 20546.

AVAILABILITY OF *STAR* ABSTRACTS ON MICROFICHE

Microfiche of the abstract sections of this issue and other issues of *STAR* are available on annual subscription from NTIS as PB90-911300, Attn: Subscriptions, 5285 Port Royal Road, Springfield, VA 22161. Annual subscription rates are $75.50 North America; $151.00 foreign. Abstract sections for previous years retroactive to 1964 are available at the current rates. Microfiche for individual *STAR* issue abstract sections are not available.

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC: NASA and NASA-sponsored documents and a large number of aerospace publications are available to the public for reference purposes at the library maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, NY 10019.

EUROPEAN: An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England, for public access. The British Library Lending Division also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols # and * from ESA - Information Retrieval Service, European Space Agency, 8-10 rue Mario-Nikis, 75738 Paris CEDEX 15, France.

FEDERAL DEPOSITORY LIBRARY PROGRAM

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 51 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 51 regional depositories. A list of the regional GPO libraries, arranged alphabetically by state, appears on the inside back cover. These libraries are *not* sales outlets. A local library can contact a Regional Depository to help locate specific reports, or direct contact may be made by an individual.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
555 West 57th Street, 12th Floor
New York, New York 10019

British Library Lending Division,
Boston Spa, Wetherby, Yorkshire,
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, DC 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

European Space Agency-Information Retrieval Service
ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

Engineering Sciences Data Unit International
P.O. Box 1633
Manassas, Virginia 22110

Engineering Sciences Data Unit International, Ltd.
251-259 Regent Street
London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik
GMBH
7514 Eggenstein Leopoldshafen
Federal Republic of Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 8757
BWI Airport, Maryland 21240

National Aeronautics and Space Administration
Scientific and Technical Information Division (NTT)
Washington, DC 20546

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library National Center
MS 950
12201 Sunrise Valley Drive
Reston, Virginia 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, Arizona 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS914
Denver, Colorado 80225

NTIS PRICE SCHEDULES

(Effective January 1, 1990)

Schedule A
STANDARD PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
A01	$ 8.00	$ 16.00
A02	11.00	22.00
A03	15.00	30.00
A04-A05	17.00	34.00
A06-A09	23.00	46.00
A10-A13	31.00	62.00
A14-A17	39.00	78.00
A18-A21	45.00	90.00
A22-A25	53.00	106.00
A99	*	*
N01	60.00	120.00
N02	59.00	118.00
N03	20.00	40.00

Schedule E
EXCEPTION PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
E01	$10.00	$ 20.00
E02	12.00	24.00
E03	14.00	28.00
E04	16.50	33.00
E05	18.50	37.00
E06	21.50	43.00
E07	24.00	48.00
E08	27.00	54.00
E09	29.50	59.00
E10	32.50	65.00
E11	35.00	70.00
E12	38.50	77.00
E13	41.00	82.00
E14	45.00	90.00
E15	48.50	97.00
E16	53.00	106.00
E17	57.50	115.00
E18	62.00	124.00
E19	69.00	138.00
E20	80.00	160.00
E99	*	*

* Contact NTIS for price quote.

IMPORTANT NOTICE

NTIS Shipping and Handling Charges

U.S., Canada, Mexico — ADD $3.00 per TOTAL ORDER

All Other Countries — ADD $4.00 per TOTAL ORDER

Exceptions — Does NOT apply to:

ORDERS REQUESTING NTIS RUSH HANDLING

ORDERS FOR SUBSCRIPTION OR STANDING ORDER PRODUCTS *ONLY*

NOTE: Each additional delivery address on an order requires a separate shipping and handling charge.

FEDERAL REGIONAL DEPOSITORY LIBRARIES

ALABAMA

AUBURN UNIV. AT MONTGOMERY LIBRARY
Documents Department
Montgomery, AL 36193
(205) 279-9110 ext.253

UNIV. OF ALABAMA LIBRARY
Reference Department/Documents
Box S
Tuscaloosa, AL 35486
(205) 348-6046

ARIZONA

DEPT. OF LIBRARY, ARCHIVES, AND PUBLIC RECORDS
Third Floor State Capitol
1700 West Washington
Phoenix, AZ 85007
(602) 255-4121

ARKANSAS

ARKANSAS STATE LIBRARY
Documents Service Section
One Capitol Mall
Little Rock, AR 72201
(501) 371-2090

CALIFORNIA

CALIFORNIA STATE LIBRARY
Govt. Publications Section
914 Capitol Mall
Sacramento, CA 95814
(916) 322-4572

COLORADO

UNIV. OF COLORADO
Norlin Library
Government Publications Division
Campus Box 184
Boulder, CO 80309
(303) 492-8834

DENVER PUBLIC LIBRARY
Govt. Pub. Department
1357 Broadway
Denver, CO 80203
(303) 571-2346

CONNECTICUT

CONNECTICUT STATE LIBRARY
231 Capitol Avenue
Hartford, CT 06106
(203) 566-4971

FLORIDA

UNIV. OF FLORIDA LIBRARIES
Documents Department
Library West
Gainesville, FL 32611
(904) 392-0367

GEORGIA

UNIV. OF GEORGIA LIBRARIES
Government Documents Dept.
Athens, GA 30602
(404) 542-8949

HAWAII

UNIV. OF HAWAII
Hamilton Library
Government Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230

IDAHO

UNIV. OF IDAHO LIBRARY
Documents Section
Moscow, ID 83843
(208) 885-6344

ILLINOIS

ILLINOIS STATE LIBRARY
Federal Documents
Centennial Building
Springfield, IL 62756
(217) 782-5012

INDIANA

INDIANA STATE LIBRARY
Serials Section
140 North Senate Avenue
Indianapolis, IN 46204
(317) 232-3686

IOWA

UNIV. OF IOWA LIBRARIES
Government Publications Dept.
Iowa City, IA 52242
(319) 335-5926

KANSAS

UNIVERSITY OF KANSAS
Spencer Research Library
Government Documents
Lawrence, KS 66045
(913) 864-4662

KENTUCKY

UNIV. OF KENTUCKY LIBRARIES
Government Publications/Maps Dept.
Lexington, KY 40506
(606) 257-8400

LOUISIANA

LOUISIANA STATE UNIVERSITY
Middleton Library
Government Documents Dept.
Baton Rouge, LA 70803
(504) 388-2570

LOUISIANA TECHNICAL UNIV.
Prescott Memorial Library
Government Documents Dept.
Ruston, LA 71272
(318) 257-4962

MAINE

UNIVERSITY OF MAINE
Raymond H. Fogler Library
Govt. Documents & Microforms Dept.
Orono, ME 04469
(207) 581-1680

MARYLAND

UNIVERSITY OF MARYLAND
McKeldin Library
Documents/Maps Room
College Park, MD 20742
(301) 454-3034

MASSACHUSETTS

BOSTON PUBLIC LIBRARY
Government Documents Dept.
666 Boylston Street
Boston, MA 02117
(617) 536-5400 ext.226

MICHIGAN

DETROIT PUBLIC LIBRARY
5201 Woodward Avenue
Detroit, MI 48202
(313) 833-1409

LIBRARY OF MICHIGAN
Government Documents
P.O. Box 30007
735 E. Michigan Avenue
Lansing, MI 48909
(517) 373-1593

MINNESOTA

UNIVERSITY OF MINNESOTA
Wilson Library
Government Publications
309 Nineteenth Avenue South
Minneapolis, MN 55455
(612) 373-7813

MISSISSIPPI

UNIV. OF MISSISSIPPI LIB.
Government Documents Dept.
106 Old Gym Bldg.
University, MS 38677
(601) 232-5857

MISSOURI

University of Missouri at Columbia Library
Government Documents
Columbia, MO 65201
(314) 882-6733

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA

UNIVERSITY OF NEBRASKA - LINCOLN
Love Memorial Library
Documents Department
Lincoln, NE 68588
(402) 472-2562

NEVADA

UNIV. OF NEVADA-RENO LIB.
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
U.S. Documents Division
5 Washington Street
P.O. Box 630
Newark, NJ 07101
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
General Library
Government Publications/Maps Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-3826

NEW YORK

NEW YORK STATE LIBRARY
Documents Sect. Cultural Educ. Ctr.
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Davis Library 080A
BA/SS Department Documents
Chapel Hill, NC 27514
(919) 962-1151

NORTH DAKOTA

NORTH DAKOTA STATE UNIVERSITY LIBRARY
Government Documents Dept.
Fargo, ND 58105
(701) 237-8352
In cooperation with Univ. of North Dakota, Chester Fritz Library
Grand Forks

OHIO

STATE LIBRARY OF OHIO
Documents Section
65 South Front Street
Columbus, OH 43266
(614) 644-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIBRARIES
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502, ext. 252

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-0489

OREGON

PORTLAND STATE UNIV.
Millar Library
934 SW Harrison - P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Publications Section
Box 1601
Walnut St. & Commonwealth Ave.
Harrisburg, PA 17105
(717) 787-3752

SOUTH CAROLINA

CLEMSON UNIV. COOPER LIB.
Documents Department
Clemson, SC 29634
(803) 656-5174
In cooperation with Univ. of South Carolina, Thomas Cooper Library, Columbia

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927 - 1201 Brazos
Austin, TX 78711
(512) 463-5455

TEXAS TECH. UNIV. LIBRARY
Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library & Learning Resources Center, UMC-30
Documents Department
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Library
Government Documents
Charlottesville, VA 22903
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Document Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Government Documents Section
P.O. Box 6069
Morgantown, WV 26506
(304) 293-3640

WISCONSIN

ST. HIST SOC. OF WISCONSIN LIB.
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-2781
In cooperation with Univ. of Wisconsin-Madison, Memorial Library

MILWAUKEE PUBLIC LIBRARY
Documents Division
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3065

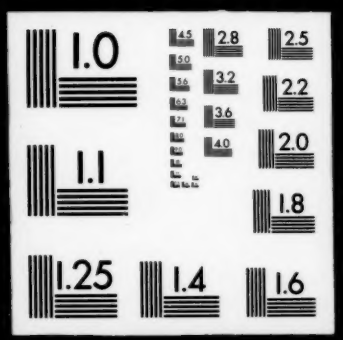
WYOMING

WYOMING STATE LIBRARY
Supreme Court & Library Bldg.
Cheyenne, WY 82002
(307) 777-5919

National Aeronautics and
Space Administration
Code NTT
Washington, D.C.
20546
Official Business
Penalty for Private Use, $300

SPECIAL FOURTH-CLASS RATE
POSTAGE & FEES PAID
NASA
PERMIT No. G27

POSTMASTER: If Undeliverable (Section 158 Postal Manual) Do Not Return


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
8.0
9.0